Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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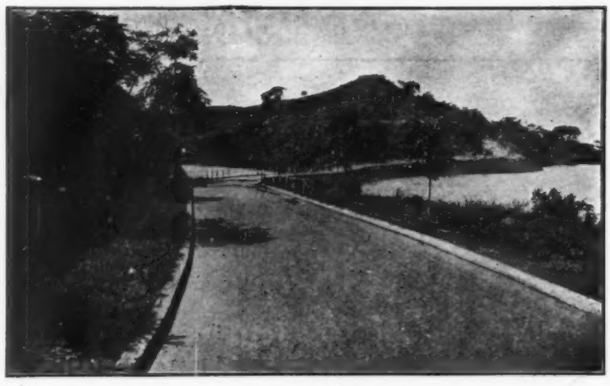
Texaco Asphalt

in the *Blazing* Sun



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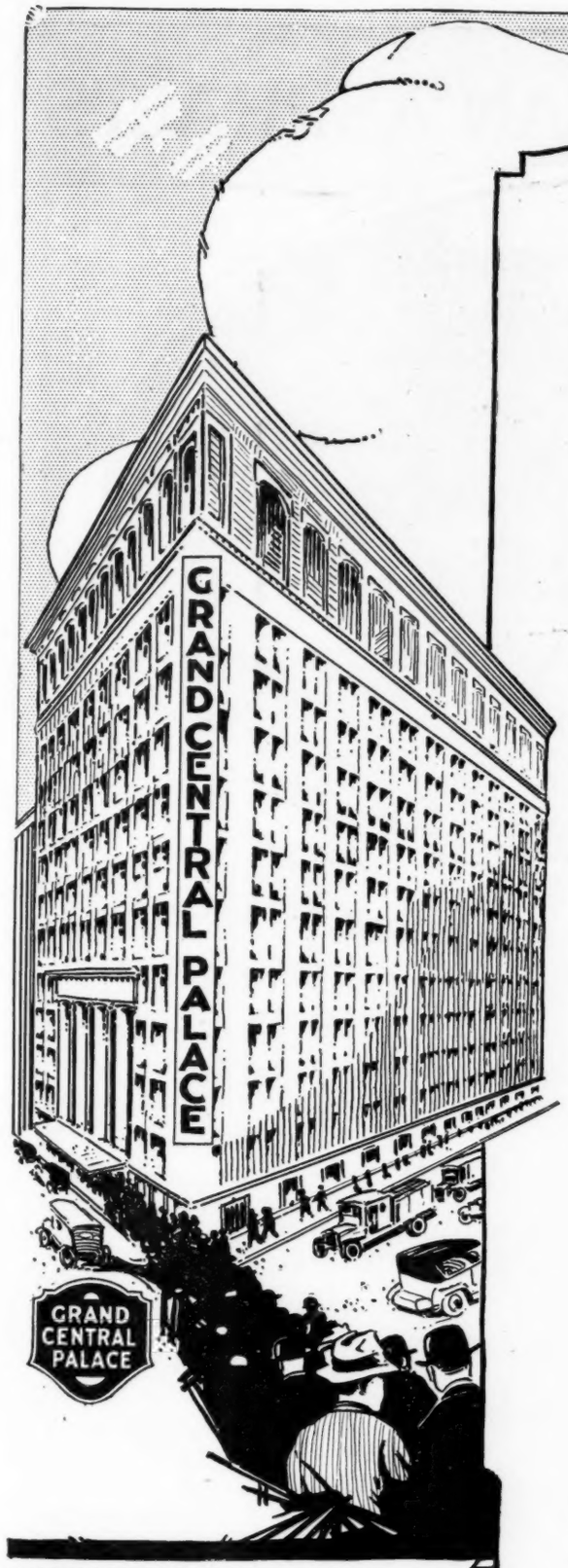

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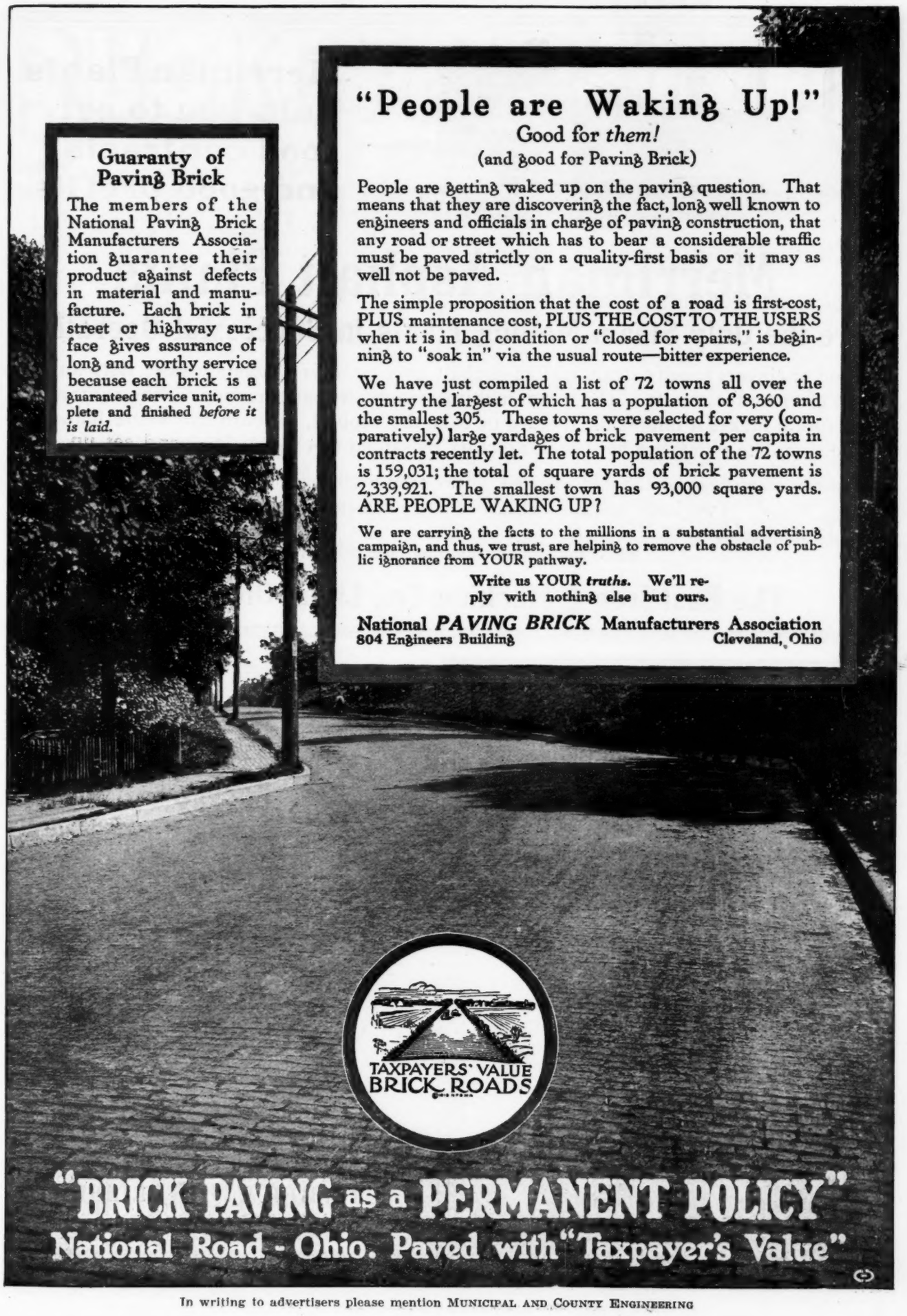
"People are Waking Up!"
Good for *them!*
(and good for Paving Brick)
People are getting waked up on the paving question. That means that they are discovering the fact, long well known to engineers and officials in charge of paving construction, that any road or street which has to bear a considerable traffic must be paved strictly on a quality-first basis or it may as well not be paved.
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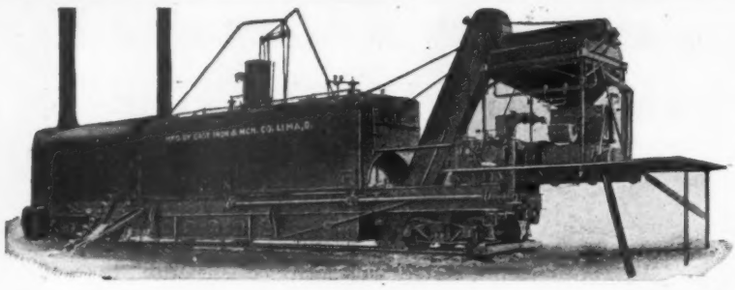

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Bulletin No. 0213 gives further details.
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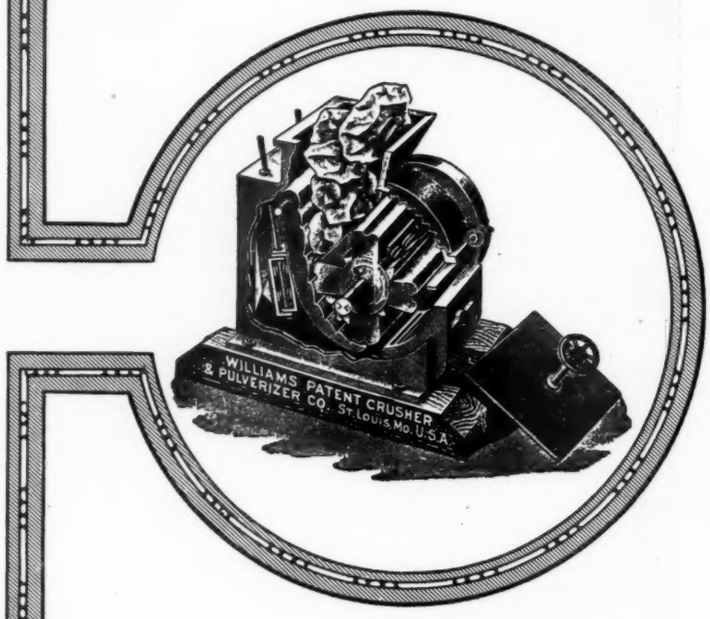

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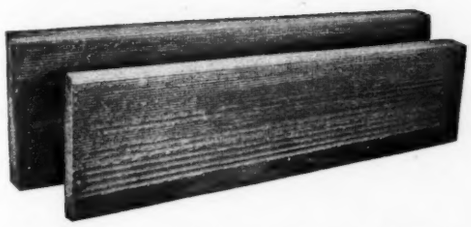

Substantial construction alone gives lasting value. Specify "Buckeye Berea" Natural Sandstone Curbing as produced by the Ohio Quarries Co., of Cleveland, O.

"The dumbest oyster can make a better pearl than the brightest man"! The oyster uses nature's methods!!

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6	.066	.010	.017	.28
7	.070	.010	.018	.29
8	.080	.010	.020	.32

This material is furnished either in rolls with an 18-inch core or in flat sheets cut to length

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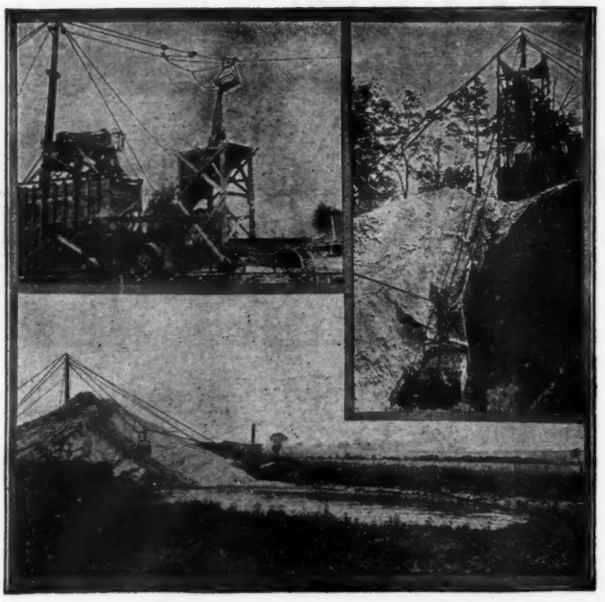

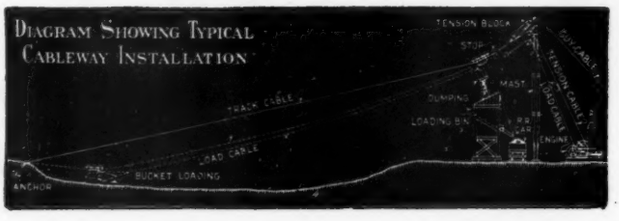

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"The Ultimate in Road Building"

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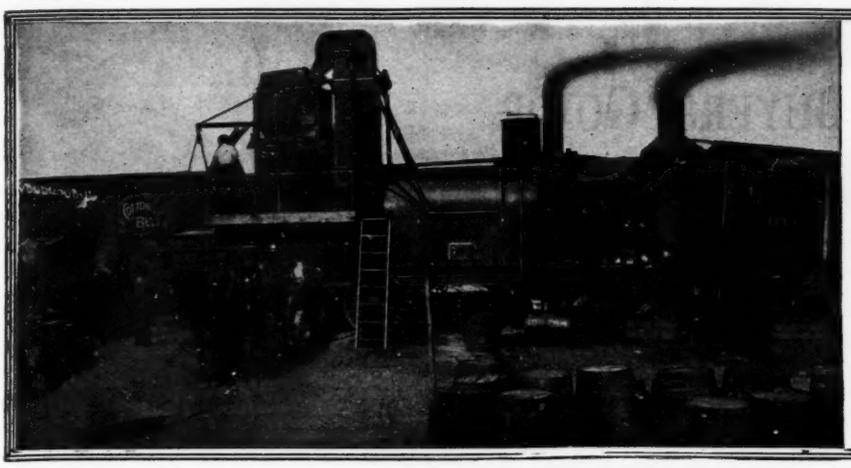

40 Years' Experience

Has equipped us to make

Iroquois Asphalt Mixing Plants, Tandem and Macadam Rollers, Heating Kettles, Tools, Etc.

The Best that can be built.

Write for Descriptive Bulletins.

IROQUOIS WORKS;
The Barber Asphalt Paving Co.
PHILADELPHIA

THE CUMMER ROAD ASPHALT PLANT

THREE SIZES THREE UNITS

Capacity 750, 1250 and 1800 Square Yards 2-inch Top or Macadam Daily

THE CUMMER ONE-CAR ASPHALT PLANT

Capacity 2000 Square Yards 2-inch Top or Macadam Daily

THE F. D. CUMMER & SON COMPANY, Cleveland, Ohio

Plants in Stock **Can Show Them in Operation**

LITTLEFORD

PATROL HEATER No. 68

CAPACITY: 8 Gallons.

Reduce your road repair cost by providing your road patrolmen with this handy **LITTLEFORD Patrol Heater No. 68,** which is very compact in design and easily handled by one man. This popular heater is durably constructed, like all **LITTLEFORD Heaters.**

Circular and Prices on request.

LITTLEFORD BROS.,
460 E. Pearl Street, Cincinnati, Ohio.

Springfield Wire-Cut Lug

IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

Springfield Paving Brick Co.
SPRINGFIELD, ILLINOIS

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Cummer & Sons Co., The F. D.

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East Iron & Machine Co.
Koehring Machine Co.
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The Texas Co.

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American Cast Iron Pipe Co.

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The Barrett Co.
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Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

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East Iron & Machine Co., The
Warren Bros. C o.

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Truscon Steel Co.

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H. H. Robertson Co.
The Texas Co.

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The Texas Co.
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Road Forms.
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Truscon Steel Co.

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Baker Mfg. Co.

Road Machinery.
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Austin-Western Road Machinery Co., The
Baker Mfg. Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Mayer, F.
Warren Bros. Co.

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Austin-Western Road Machinery Co.

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Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
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Barber Asphalt Paving Co.

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East Iron & Machine Co., The

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Cummer & Son Co., The F. D.

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Pawling and Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.
Electrolytic Sanitation Co.
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Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

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Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt, Lewis
Vitrified Pipe Mfrs. Assn.

Sewer Rods.
Stewart, W. H.

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Austin-Western Road Machinery Co.
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Cleveland Stone Co.
Ohio Quarries Co.

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Austin-Western Road Machinery Co.

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Cleveland Stone Co.
Ohio Quarries Co.

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Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
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Lufkin Rule Co., The

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Austin-Western Road Machinery Co., The
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Pawling and Harnischfeger.

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Mensch, L. J.

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DuPont Chemical Co.

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Alger Supply Co.
Littleford Bros.

Tarvia.
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Dow & Smith
Howard, J. W.
Kirschbraun, Lester
Van Trump, Isaac.

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Tractors.
F. C. Austin Co., Inc.

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Warner Mfg. Co.

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Kalamazoo Fdy. & Mach. Co.

Trench Machinery.
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Cast Iron Pipe Publicity Bureau

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The Texas Co.
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Direct Oxidation Process Corp.
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Alger Supply Co.
Cast Iron Pipe Publicity Bureau
Coldwell-Wilcox Co.
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Austin-Western Road Machinery Co.

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Truscon Steel Co.

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Medal Paving Brick Co.
Murphysboro Paving Brick Co.
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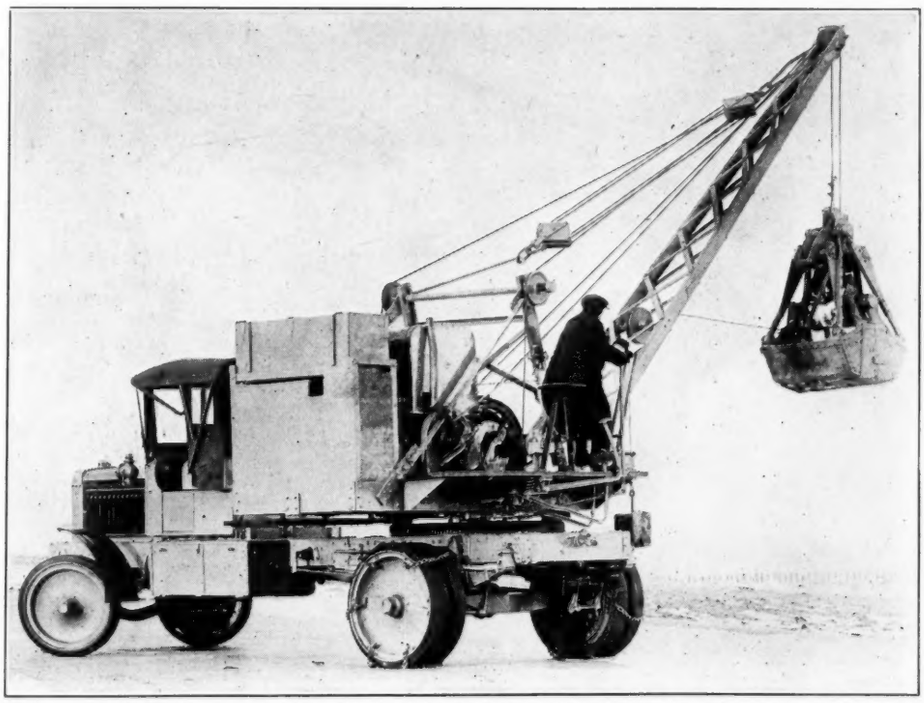
Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation



WINTHER AUTOMOTIVE 7-TON DERRICK AS OPERATED IN HIGHWAY AND OTHER EARTH AND MATERIAL MOVING WORK.

Printed as insert to Municipal and County Engineering, Chicago, Ill., October, 1919.

Steady increase in sales demands enlarged facilities

July, 1919, almost doubled any previous month in the number of orders booked for Autocar Motor Trucks. The first six months were by far the biggest of any six months in the history of the Autocar Company.

The capitalization of the Autocar Company has been increased—manufacturing and service facilities are being enlarged—to care for the growing demand for Autocars.

The policy of the Autocar Company puts at the disposal of Autocar users complete service facilities.

Chassis (1½-2 ton)
$2300 97-in. wheelbase
$2400 150-in. wheelbase

The Autocar Company is represented by factory branches and dealers from coast to coast. Through them it assures complete aftersale service to every Autocar user.

THE AUTOCAR COMPANY
Ardmore, Pa. **Established 1897**

Autocar

Wilson Dependable Motor Trucks

EIGHTEEN MONTHS AHEAD OF UNCLE SAM

In 1916 the present 3½ and 5-ton Wilson trucks were designed and placed in production. In 1917 all the leading automotive engineers of the United States, under stress of war conditions, designed the Class B Army Truck.

Compare the features of the Wilson 3½ and 5-ton Chassis design which were later incorporated by the War Department in the Class B truck.

Load Distribution—
Practically 80 per cent on rear axle.

Wheel Base—
Wilson, 160 inches; Class B, 160½ inches.

Frame—
Straight member, channel section, hot riveted throughout, flexible design.

Motor—
Three point suspension. Cylinders cast in pairs, Bell housing type of crank case for clutch, Centrifugal type of water pump. Wide, flat fan belt, gear connected governor. High tension, waterproof magneto. Bronze backed, babbitt bearings for crankshaft and connecting rods. Lubrication by double plunger pumps and splash. "L" head type of cylinder castings. Valves interchangeable. Inclosed valve stems. Four-bladed, ball-bearing fan.

Radiator—
Built-up type with removable core and cast iron top and bottom tanks and side bars. Vertical tubes with fins. Large oval filler cap.

Clutch—
Multiple disc (dry).

Transmission—
Three-point suspension, and ships in frame. Four speeds forward. Shafts mounted in vertical position. Shifter rods placed above main shaft. Ball bearings. Oil filler spout mounted on side of case.

Drive and Propeller Shafts—
Similar in all details.

Chassis Lubrication—
Oil throughout.

Springs—
Semi-eliptic front and rear. Flat design. Eyes bronze bushed.

Spring Clips—
Nickel steel.

Drive—
"Hotchkiss."

Axles—
Front: "I"-beam type, one piece, drop forging with dropped center. Steering knuckles, Elliott jaw type with Timken roller bearings in the upper end. Wheel spindles fitted with Timken roller bearings. Rear: Worm and worm gear type. Pressed steel housing, electrically welded. Full floating type with Timken roller bearings throughout. Brake rod assembly mounted on front and rear of axle housing.

Brakes—
Two sets operating on rear wheel drums, expanding type.

Steer—
Fore and aft, with trunnion type of gear mounting on frame.

Control—
Gear shift and emergency brake levers mounted in center.

Wheels—
Front, 36 inches; rear, 40 inches. Artillery type.

Dash—
Heavy pressed steel.

Fenders—
Short and of heavy construction.

Seat—
Wide, with two cushions.

Gasoline Feed—
Gravity, from tank located under seat.

Step—
Heavy steel (no running boards).

YOU can SELL Wilson Trucks. Write for open territory.

J. C. WILSON COMPANY, 36th Year Detroit, Mich.

MOTOR TRUCK OPERATION AND ACCOUNTING L

Experience in Selling Trucks in the Public Works Field

Of unusual interest is a letter telling of the experience of the Missouri Valley Bridge and Iron Co., Leavenworth, Kans., in selling motor trucks in the public works field. This letter to the editor from John R. Key, manager of the road machinery department of the company named, follows:

"We watched the public works field for some two years to determine what class of motor trucks seemed to best fill the requirements and after satisfying our minds on this point we selected the Hall as one of those meeting the requirements of this trade, and in the three years we have been selling the Hall truck, we have had no experience to indicate our judgment in this respect was faulty.

"We have found that prospects in the various branches of this field must be reached through different appeals, though in the end they all come back to the two main points—efficiency and economy.

"Our activities in this line have only extended to the Highway and Street Officials and Contractor trade, with one exception, where we sold a 3½ ton dump truck to the School Board of the City of Leavenworth, who use it for supplying each of the school buildings with coal and also to transfer various items of school property as required. This school Board tell us that they are effecting a saving of about $1,800 per year over the old method, which is a saving deserving of the most serious consideration, and we question if it is possible for the school board to effect such a saving on any other items going into their general expense and at the same time gain in efficiency.

"We have sold a number of trucks to Boards of County Commissioners for general use in their road work, such as hauling cement, sand, stone, culvert forms, etc.; also concrete mixers, rock crushers and other equipment used in their culvert construction, and bridge repair work, and they not infrequently use their trucks in transporting labor to and from the jobs. Some counties, we find, who have the necessary equipment, lay out a schedule for their culvert construction and bridge repair work early in the spring and their labor gangs move from place to place with the equipment, materials and supplies, and in this manner not only effect a great saving to the county but at the same time get this class of work all completed for the year and out of the way before the work of road grading and construction starts.

"Some of the counties have oiling units which they either set on the truck chassis or inside the dump body. These are self-contained units consisting of the oil tank, distributing pipes and independent motor driven pump which furnishes the pressure for breaking up and spraying the oil, and this same motor and pump is often used for filling the oiler tank where conditions indicate such procedure. The use of the motor truck in road oiling not only effects a saving in transportation and labor cost but not infrequently saves quite a demurrage bill where the oil is taken direct from the tank car for distribution. Another thing in favor of the truck for such use is that generally the oil is heated in the tank car and when such is the case it can be transported to point of application so quickly that it cools very little before being applied, and a slight super-heating at a tank car will easily take care of any cooling in transit.

"The motor truck has made possible the building of considerable mileage of good gravel road where available gravel beds were located some distance from the road site, and because of this distance team hauling would be impractical and too expensive.

"The truck we have sold the highway and street contractors, has been used along the same lines and for about the same purposes as those sold to officials. The 3½ ton size seems to better meet the general demand than any other, and we find that our customers agree that they can safely figure a truck of this size to do the work of six teams and to effect a saving of 50% over team work. This we believe to be a safe average working proposition on this class of work, and the highway officials and contractors are now figuring in terms of trucks instead of teams as formerly."

G. W. Buroughs, chief clerk, Department of Public Works, City of Tacoma, Washington, gives the data shown in the accompanying tabulation on the performance of the Department's 5½-ton Mack truck, used in hauling gravel for the repairing of ungraded streets and alleys during the year 1917. He states that "the truck is still in constant service and has always given entire satisfaction." His tabulation shows that the saving due to motor haulage on this work was at the rate of 79¼ cts per cubic yard of gravel handled.

REPORT OF 5½-TON MACK TRUCK, OWNED BY CITY OF TACOMA, WASH., FROM APRIL 16 (WHEN STARTED) TO END OF NOVEMBER, YEAR 1917

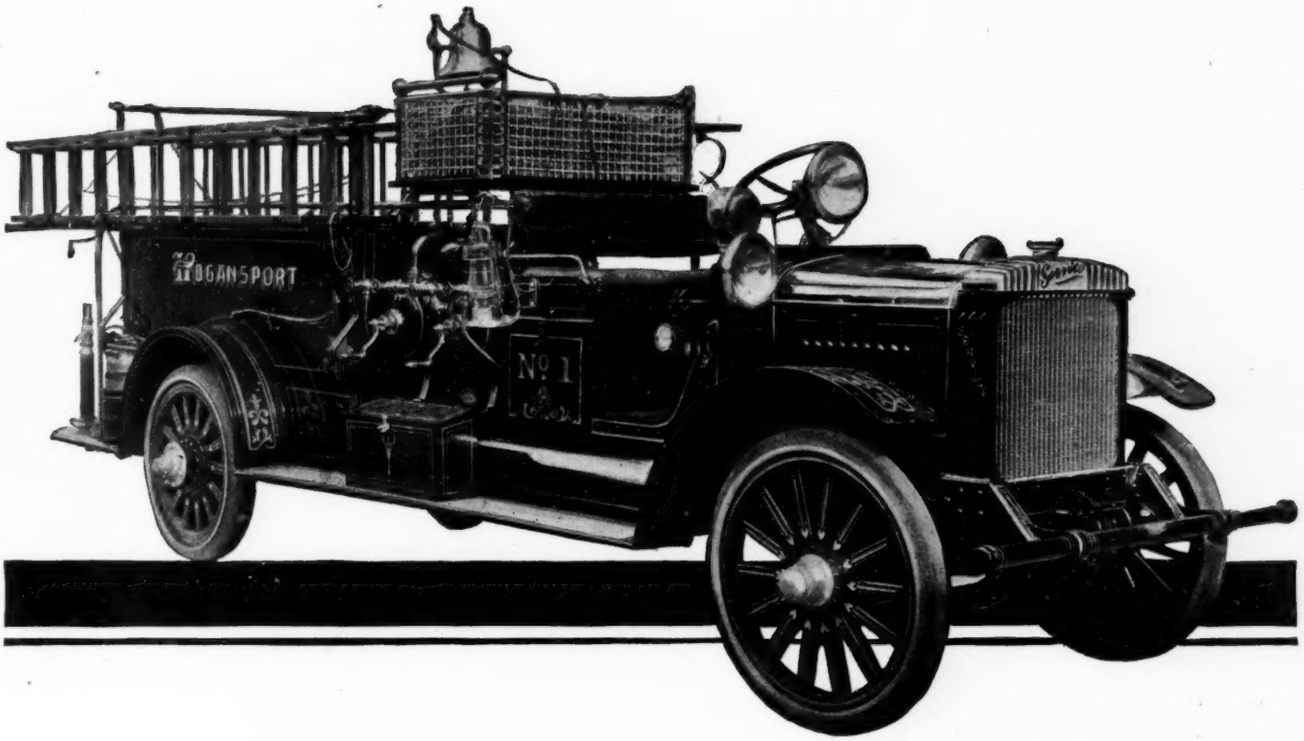
Month	Miles	Yards Hauled	Gals. Gas	Pints Oil	Pounds Grease	Hours Running	Hours care and Cleaning	
April	556	607.5	215	114	10	96	16	
May	2,003	2,336	694.5	318		300	32	
June	1,998	1,871.5	737.5	400	10	348	32	
July	2,027	1,412.5	740.0	344		348	40	Laid up 4 days account Rep. Bunkers.
August	1,611	738	558	258	10	241	40	Laid up 4 days account Rep. Bunkers.
September ..	627	467	293	116	10	130	24	Up to and including 19th; Bal. Month on Mun. car line.
October								All month on car line.
November ..	1,230	792	469	224	10	233	32	Actual running time 212 days of 8 hours.
Total	10,052	8,234.5	3,707	1,774	50	1,696	216	

Summary—10,052 miles, or 1,834 trips, at 5.481 miles per round trip, or 2¾ miles average haul. Average time loading, 50 Secs. 8,234 yards hauled 2¾ miles equals 22,643 yards hauled 1 mile at $2,716.16 or 12cts. per yard-mile.

COST DATA

1,696	Hours running	Wages	$805.60
216	Hours care and cleaning...	Wages	102.60
3,707	Gals. gasoline, at	$0.18	667.26
222	Gals. oil, at	.40	88.80
50	Lbs. hard cup grease, at..	.08¾	4.38
180	Lbs. transmission grease, at	.07	12.60
5	Gals. ice machine oil, at...	.39	1.95
1	Set 40x12 tires worn out...		312.22
1	paid new chains		120.00
	Sundry repairs		97.75
	Depreciation of truck.....		500.00
			$2,716.16

As compared with teams at prevailing wages of $8 per day:
Teams travel, loaded and light, average 2½ miles per hour.
20 miles per day, each trip 5.481 mi. gives 3.65 trips per day at cost of $8.00.
3.65 trips daily at 2 yds. gives 7.3 yds. costing $8 or $1.096 per yd. for a team.
8.64 trips daily at 4½ yds. gives 38.88 yds. costing $12.81 or $0.3035 per yd. for truck.
Saving by truck, 79.25 cts. per yd., and on 8,234.5 yds. amounts to $6,525.84.



SERVICE protects Logansport

Logansport, Ind., like scores of other cities, is protected against the ravages of fire by SERVICE Motor Truck fire fighting equipment.

On the ability of fire apparatus to give dependable service hangs the lives and property value of your community. SERVICE Model 36 is specially designed and adapted for this work, and is as near 100 per cent. efficient as a motor truck can be.

Service
MOTOR TRUCKS

equipped with fire fighting apparatus and other specialized bodies are in use by Chicago, Indianapolis, Columbus, Atlanta, Kansas City, and many other cities.

There is a SERVICE to meet your exact requirements.

Write for information.

SERVICE MOTOR TRUCK CO., *WABASH, IND., U. S. A.*

Distributors in all principal cities and foreign countries.

NEW YORK: 87-89 West End Ave. **CHICAGO: 2617-25 S. Wabash Ave.**

Performance of White Trucks in Public Works Field

Sanborn C. Sleeper, assistant engineer with the Luce County road commission, Newberry, Mich., gives us some exceedingly interesting facts and figures about the performance of the White trucks operated by the commission. He writes: "I note that you ask for a comparison of hauling with motor trucks and with horses. We have arrived at the conclusion by a study of conditions in actual practice that when the length of the haul gets beyond one mile that it would be ridiculous and uneconomical to use horses in this day and age. The hauling costs with trucks will decrease with the length of haul while with horses the results are directly opposite.

"I might go much more into detail as to the efficiency of White trucks, but instead present herewith a copy of our cost and performance record for the year 1918:

WORK PERFORMED BY TWO WHITE 5-TON TRUCKS
Luce County Road Commission, Newberry, Michigan
—1918—

Truck No. 1

Fixed Charges—	
Interest at 6% per annum	$ 288.00
Insurance (none)	
Operating Charges—	
Depreciation 100,000 miles (truck value minus tires)	255.16
Total wages of driver	319.74
Gasoline—1,377 gals. @ 25 cts.	344.25
Lubricating oil—117 gals. @ 56 cts.	65.52
Hard oil—128.5 lbs. @ 06 cts.	7.71
Waste—20 lbs. @ 20 cts.	4.00
Tire depreciation—5,316 miles @ 03 cts.	159.48
Repairs and renewals	160.00
Operating Charges	$1,315.86
Fixed Charges	288.00
Total	$1,603.86
Performance—	
Average Haul in miles	5.54
No. of yards hauled	1,863
Total number of yd. miles performed 10,321	$0.155 yd. mile
Total number of ton miles performed 15,481	0.104 ton mile

Truck No. 2

Fixed Charges—	
Interest at 6% per annum	$ 288.00
Insurance (none)	
Operating Charges—	
Depreciation 100,000 miles (truck value minus tires)	237.40
Total wages of driver	297.00
Gasoline—1,235 gals. @ 25 cts.	308.75
Lubricating oil—123 gals. @ 56 cts.	68.88
Hard oil—121 lbs. @ 06 cts.	7.26
Waste—21.5 lbs. @ 20 cts.	4.30
Tire depreciation—4,946 miles @ 03 cts.	148.38
Repairs and renewals	131.00
Operating Charges	$1,202.97
Fixed Charges	288.00
Total	$1,490.97
Performance—	
Average Haul in miles	5.54
No. of yards hauled	1,780
Total number of yd. miles performed 9.861	$0.151 yd. mile
Total number of ton miles performed 14.791	0.101 ton mile

L. M. Markham, County Clerk of Prowers County, Lamar, Colorado, writes as follows regarding the operation of White motor trucks on the county highways:

"For some months Prowers County has had in operation two 3½ ton White trucks with self-dumping bodies, and one 5-ton self-dumping body Republic truck. These trucks have been used mostly in the graveling of State highways. A fairly accurate account of the cost of operation and work performed shows that this graveling is being done upon the state highways at a cost of approximately 83 cents per cubic yard, the haul averaging 3¼ miles. The cost given includes the screening of the gravel by means of a 30 ton Gallion screening plant."

John Brown, chairman of the Shelby County Commissioners, Memphis, Tenn., writes:

"We operate several White trucks on highway work. The work consists of hauling gravel and other road material, and also in hauling lumber to construct and repair bridges. These trucks have, in the main, proven satisfactory. We also use a great many wagons and teams. It is my opinion that it is false economy to haul any road material, of any character pertaining to road building, other than by truck."

The Winther Automotive Derrick

A Winther automotive 7-ton derrick is illustrated on the title page of this motor truck section. So far as we know this is the only 7-ton chassis ever used as an automotive derrick and its advantages over the steam shovel are claimed to be marked. The initial cost of this outfit is much less than that of a steam shovel and its operation is said to be much less expensive. The chassis can be moved from place to place very easily and can be used not only for excavating work, but also for unloading freight cars, steamboats, etc., and is being so used in several government posts. The lifting capacity of the hoist is 8,000 lbs.

About 50 of these automotive derricks were built for the U. S. Government by the Winther Motor Truck Co. of Kenosha, Wis., and were originally intended for reconstruction work in France and Belgium, and also for work about the yards and docks in Brest. The sudden termination of the war, however, caused these trucks to be diverted to the various navy yards and docks and training stations throughout the country, while some will be used in road work.

Establishing Return Load Bureaus

The necessity of establishing Return Load Bureaus in the different cities to aid in the development of intercity truck haulage is explained by M. L. Pulcher, General Manager of the Federal Motor Truck Co., of Detroit, Mich.

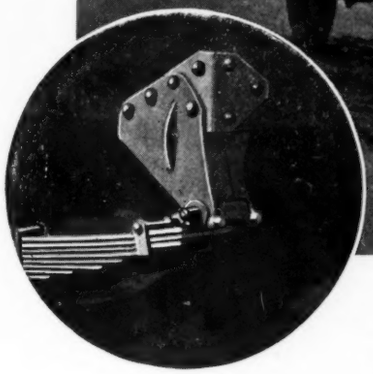
These bureaus are established for the purpose of distributing the freight so that the truckman is assured of a return load when he brings a load from one city to another. The Chambers of Commerce in many cities have given valuable assistance in this line in many instances, even going so far as to establish bureaus under their control in an effort to relieve freight congestion in certain sections and cities. The work entails, however, concentrated and aggressive effort; and the services of a salaried representative with permanent headquarters are absolutely necessary, so that it is usually found more satisfactory to establish these bureaus under the direction of the truck men themselves.

Both shipper and operator find it to their advantage to finance such a clearing house themselves. This is easily arranged by charging commissions on all shipments arranged by the bureau. Truck operators should arrange a rate midway between the tariff charged by railroads and the express companies. The return load is very important. Although the loaded truck consumes more gasoline, the light truck more than offsets this expense in wear and tear on the mechanical parts through vibration, and the additional receipts of the return load help to cut down overhead and add to profits.

"Ground Grippers" for Truck Wheels

The Fulton "Ground Grippers" have been announced by the Fulton Motor Truck Co., Farmingdale, Long Island. These

FULTON GROUND GRIPPERS ON 2-TON FULTON TRUCK, SHOWING CLEARANCE OF HARD ROAD SURFACE WITH NO DAMAGE TO HIGHWAY.



Road Oiling Outfit mounted on Gramm-Bernstein Chassis, operating in Morgan County, Illinois.

Note How this Spring Hanger Adds to the Truck's Life

The front spring hanger of a truck appears to be a minor detail. In reality, it is a vital engineering point. Its design actually influences the very life of the truck.

Gramm-Bernstein front spring hangers are not extensions of the frame side-members. We use a heavy cast steel hanger.

The same care and engineering skill which B. A. Gramm applies to this one thing is evident throughout the Gramm-Bernstein truck.

One of the results we get is a much stauncher front end, far less liable to serious damage.

Another is increased loading space back of the seat, on a proportionately shorter wheelbase, and a better load distribution.

Most important of all, this better load distribution makes the truck steer better, pound less on the road, and therefore last longer.

It is obvious that Gramm-Bernstein's greater loading space increases the truck's usefulness as a freight carrier.

It is equally obvious that our comparatively shorter wheelbase adds greatly to tractive efficiency and to economy, and gives a shorter turning radius.

In other words, these are exactly the results a business man wants in his truck.

Gramm-Bernstein Trucks in 2, 2½, 3½ and 5-ton capacities, are now sold completely equipped, ready for the body—not an extra to buy.

All Gramm-Bernstein Transmissions are provided with a pad for attaching Gramm's Basic Patent Power Take-off. Dealers and truck owners should assure themselves that any trucks purchased with power take-off do not infringe B. A. Gramm's Basic Patent No. 1194994.

GRAMM PIONEER BERNSTEIN

The Gramm-Bernstein Motor Truck Co.

Pioneers since 1901—Builders of the First Liberty (U. S. A.) Truck

Lima, Ohio, U. S. A.

grippers are designed to promote the wider use of the motor truck in direct transportation from the fields to the market. As the accompanying illustration shows, the grippers are so placed upon the wheels that they do not come in contact with hard surfaces and so do not injure hard surfaced roadways. They grip as soon as the wheels bear down into soft material.

Ground grippers are wide iron bands with metal flanges bolted diagonally across the outside of the band. These flanges are similar to those found on tractor wheels. They are attached to the wheel of the truck in a simple way and 20 minutes are required to place all four bands in position for work. There are four 12-in. bolts used with special wide metal bands. These bolts are attached to two angle iron strips, which are held in position by two spokes. The bolts from these strips are attached by nut and washer to the band and quickly tightened.

Thorough tests have been made with the ground grippers for some time. On freshly ploughed fields the grippers have enabled the transportation of heavy loads and have given satisfaction. The farmer, by using the ground grippers, has been able to dispense with the use of horses to haul four and five loads from the field to make up the truck load on the hard highway. He has been able to transport fertilizer to the field direct and distribute it without loss of time reloading to horse-drawn wagons at the field. Harvesting of crops has been simplified, the truck passing steadily along the fields while being loaded. Passing from the field to the road the grippers are left in position as the flanges are so placed that they clear the road bed and cause no injury to it, but in the event of heavy going on the road the flanges immediately take hold and are of assistance again in reaching the market.

Use of Loading Devices Adds Greatly to Motor Truck Operating Efficiency and Economy

The ability of the motor truck to carry bulk materials long distances at a high rate of speed, and in quantities impossible with any other form of conveyance, makes it possible materially to reduce the cost of transporting large quantities of stone, coal, sand, gravel, coke, ashes and other heavy materials. In many cases the truck is loaded from an overhead chute, but more often the material to be moved lies in storage piles, and it is the cost of loading this ground storage material that has retarded the sale of trucks for this work.

In order to haul several tons at a load the truck must necessarily be built high to hold the load. Shoveling by hand is not only slow and expensive but the truck and its driver are compelled to stand idle the greater part of their time waiting on the shovelers, who are also idle between trips.

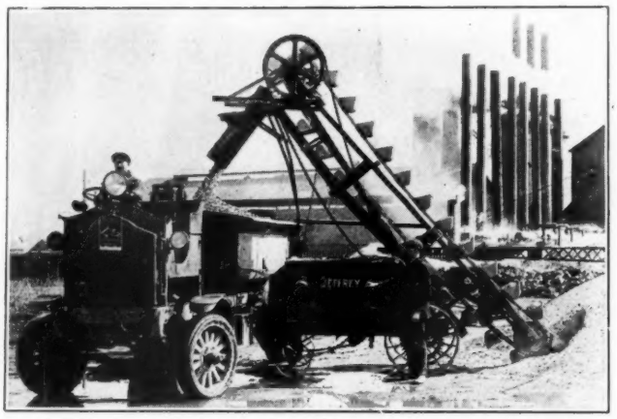
That is why the Jeffrey portable self-propelling loaders are proving a highly profitable investment to contractors and others handling considerable quantities of material from ground storage, and are rapidly superseding the old hand-shoveling method.

These machines it is claimed will easily load 1 to 1¼ tons of coal per minute, and are guaranteed to handle coal up to 6-in. cubes, with occasional larger lumps. Their capacity when handling crushed stone, sand, gravel and similar materials is 1 to 1½ cu. yds. per minute. They are guaranteed to handle crushed stone up to 3½ in. ring.

The Jeffrey loader consists essentially of a bucket elevator inclined at about 45 degrees, mounted on all steel self-propelling truck, enabling the machine to dig into the pit under its own power, and elevate the material to a sufficient height to discharge into wagons, trucks or trailers.

Much emphasis is laid on the self-propelling device of the Jeffrey loader, eliminating as it does the necessity of using several laborers to move the machine from place to place. One user has stated that "a loader without this feature would not be a success." The self-propelling feature also makes it possible to build the machine substantial enough to stand up under the heavy work of loading sand, gravel, crushed stone and similar materials. One unskilled laborer can easily operate the machine as all operating levers and steering wheel are on one side.

In addition to the time and expense which is saved in loading there is a greatly increased efficiency of the trucks hauling the material. The time saved by the elimination of long waits while loading, enables the trucks or wagons to make more trips daily, which means quicker and better service and greater profits to owners.



JEFFREY SELF-PROPELLING LOADER HANDLING CRUSHED STONE FROM GROUND STORAGE TO TRUCK.

The accompanying view shows a Jeffrey self-propelling loader handling crushed stone from ground storage to truck at the plant of the Southern Gravel & Supply Co., Columbus, Ohio. Sand was formerly loaded into the trucks by hand shovelers. This was replaced by a Jeffrey loader, not only on account of the high cost of labor, but also for the reason that the trucks were delayed in being loaded. The loader will load a 7-ton Sterling truck in from six to eight minutes. In one afternoon they loaded 187 10-yard wagons with it, and the machine paid for itself in less than two months service.

HAISS PATH DIGGING LOADER IN OPERATION.

A Haiss Path digging loader is here shown digging and loading stone from a pile and loading it into a motor truck. In this machine the potential feeding propellers dig into the material the full width of the loader and convey the material into the buckets where it is elevated into the trucks. This machine is equipped with two speeds reverse and one speed forward. It has a slow speed worm gear which propels the wagon loader back into the material at the rate of 30 ins. per minute. This loader is automatic in the sense that it is not

Building The Right Sized Trucks To Fit Each Transportation Requirement

By George A. Kissel

Experience has proven that a motor truck to be operated economically and efficiently must, above everything else, fit the purpose for which it is to be used. A misfit truck means not only high upkeep, but an investment that will prove a liability, because either too much ability will be expected or too little service will be realized. In the first instance, the overload will produce premature depreciation and big repair expense; in the second instance, you are paying for excess capacity not utilized.

Kissel "General Delivery" Model

The Results of Buying Adaptable Units

By purchasing truck units of the proper size and capacity for your requirements, the following advantages will result—

1—Lowest cost per ton mile.
2—Low gasoline and oil consumption.
3—Minimum wear on tires.
4—Maximum power at minimum expense.
5—Most efficient operation of all fixed or moving units.
6—Minimized wear and depreciation.
7—Big saving in time and labor.
8—Elimination of breaks or overstrain.
9—Lowest service expense.
10—Small capital invested in parts stock.

The fact that the Kissel Motor Car Company builds five different sized trucks, from the "General Delivery" ¾ to 1 ton to the "Goliath" 5-ton model, insures a truck for every purpose, a size for every business, and that is why fleet owners are standardizing their equipment with Kissel Trucks.

In other words—it is just as necessary to **standardize on the proper size model** as it is to standardize on one make. Therefore fleet owners realize that different sized models of the same make is the height of fleet efficiency and economy.

Way back in 1906 we realized the necessity of building the proper size trucks to fit the purpose for which they were purchased. To do this successfully our designers and engineers studied the different requirements each line of business would demand.

A Size for Every Purpose

No matter what transportation demands and problems you are up against, your nearest Kissel dealer can supply you with the proper size Kissel Truck that will economically and efficiently meet your transportation demands as if that truck were built to your own specifications.

"General Delivery" model, (capacity 2250 lbs. including body)—for **retailers** and **merchants** who want a quick delivery truck for speedy work in city and suburban districts—for **manufacturers** and **wholesalers** who want a light truck as auxiliary to their heavier models—for **farmers** who want a reliable light delivery truck equipped with a good loading space and ability to carry loads at a good rate of speed.

"General Utility" model, (capacity 4000 lbs. including body) built for **retail lumber, furniture, hardware, soft drinks, department and similar stores,** and delivery of **freight, farm products, dairy** and **milk products.** Adaptable for **passenger** and **depot busses, drayage** and **transfer** systems.

Kissel "General Utility" Model

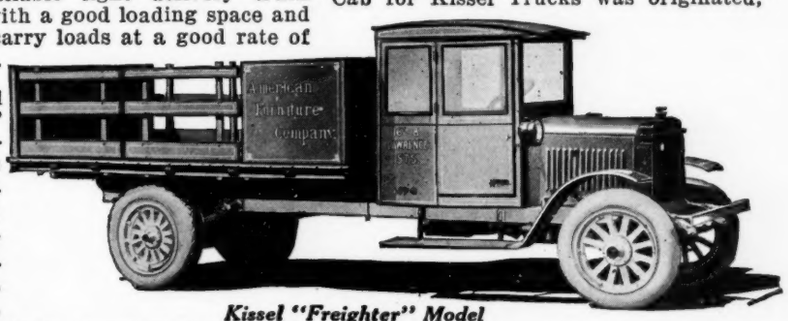
"Freighter" model (capacity 5200 lbs. including body)—the masterpiece of the 2-ton field that comes nearer in performance and ability to the 2-ton U. S. Army "A" truck than any other 2-ton truck on the market. The ideal truck for **transportation and express companies, rural motor express, roadbuilders, contractors, excavators, municipal work, farmers, manufacturers, wholesalers, coal and wood dealers,** etc.

"Heavy Duty" model (capacity 8600 lbs. including body)—for **contractors, road builders, express** and **moving companies** that specialize on heavy haulage; is particularly suitable for hauling of **lumber, stone, brick, machinery, gravel, cement, materials for street, sprinkling, flushing and oiling.**

"Goliath" model (capacity 11800 lbs. including body). A brute for **heavy work,** a giant in power and strength when **tons of dead weight** are to be transported and delivered short or long distances over all kinds of roads and up different grades—strong and capable for **any emergency** or **the heaviest load.**

Uninterrupted Transportation This Winter

To insure Uninterrupted Transportation the year around, the ALL-YEAR Cab for Kissel Trucks was originated, perfected and patented. By adding the winter attachments — side door and window attachments, the open cab—standard equipment on the four largest Kissel models,—is quickly changed to an enclosed cab, warm, dry and comfortable—giving complete protection to drivers in the most severe winter weather — eliminating layups on account of storms and increasing efficiency of drivers.



Kissel "Freighter" Model

The nearest Kissel dealer will study your transportation requirements to insure your getting the right sized Kissel Truck, reducing your transportation expenses to the proper ratio of goods hauled and miles covered. Specifications, price, etc., sent on request.

Kissel Motor Car Co., Hartford, Wis.
U. S. A.

Kissel "Heavy Duty" Model

Trucks earn money only when working

EVERY minute a truck spends in the shop is a double expense. It is earning money only when working.

Trucks must be built right to keep out of the shop, but more is necessary—

They must be inspected regularly to prevent troubles due to natural wear and unnatural abuse.

That is why we maintain a monthly inspection service, by factory-trained inspectors—to make sure your trucks make good and continue to earn money.

That is why Pierce-Arrows are the most economical trucks in service. They are always on the job.

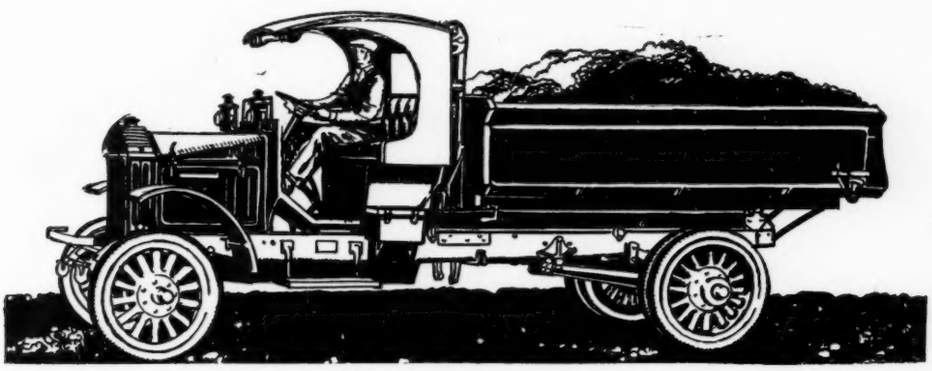
You cannot afford trucks that lose time when they should be on the job, earning money.

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

EIGHTY-THREE hauling contractors operating 457 Pierce-Arrow Trucks in Metropolitan New York attest their superiority for haulage work because they

sustain a higher average speed without deterioration,
work longer hours without interruption,
haul more loads in a given time.

Measured by work done, Pierce-Arrow is the cheapest to buy.



Delivers more work in a given time;
Loses less time on the job and off the job;
Costs less to operate and less to maintain;
Lasts longer, depreciates less and commands a higher resale price at all times.

THE PIERCE-ARROW MOTOR CAR CO.
BUFFALO, N. Y.

Pierce Arrow

necessary for a laborer to shovel the material into the bucket.

The Heltzel lighting loader skip is well known to readers of this magazine. These loaders save time, labor and money according to the testimony of numerous contractors and public works officials. They are made in 1 and 1½ cu. yd. sizes and are widely employed in this field in keeping men and motor trucks on the move.

LEE LOADERS IN OPERATION AT "TEAM" TRACK. FILLED AND READY TO DISCHARGE INTO A WHITE GOOD ROADS TRUCK.

A Lee loader is illustrated herewith. It is claimed that a motor truck is not held more than five minutes at the most for any haulage operation where these loaders are used at the loading point. An object all road builders are striving for is to have their loose material handled at the lowest obtainable cost. These loaders fit in with that phase of the hauling which has to do with taking material from cars. In the accompanying view the two loaders are both in the loading position and have been filled by shovellers in the gondola car. These loaders are free from intricate mechanism and so can be used successfully by common labor.

Loading Aids on Pierce-Arrow Trucks Cut Operating Costs

Under this title Mr. Carl H. Bowen contributed a very timely article to the September number of the Pierce-Arrow Salesman. The article, here reprinted in part by permission, tells how winches, hoists, belt conveyors and other devices prevent the loss of much valuable time.

The problem arising in connection with motor truck use is that of economical operation. To effect economy the operation of loading and unloading must be reduced to minimum time.

In analyzing a transportation problem emphasis is laid upon the time required to load and unload. This is especially so in the case of the short hauls, where it is often found that the loading and unloading time is greater than the running time. The idle truck is the expensive truck—no return coming in on the investment.

Objects of solid make-up as granite, boxes, bales, crates, etc., are comparatively simple to handle. Materials such as coal, ashes, gravel, sand and asphalt take the greater amount of time and effort to load.

Unloading loose materials is easy when use is made of a dump body. Realizing this the Pierce-Arrow Car Company developed an unusual line of dump bodies made of steel entirely or of wood lined with steel. These bodies are all operated by the Pierce-Arrow Hydraulic Hoist.

The hoist is made of the best material obtainable and according to the Pierce-Arrow idea of quality. It is so constructed that it may be detached from the chassis as a unit with no alteration to the truck chassis. The hoist is operated by a power take-off shaft driven by the truck engine and is operated by the driver without leaving his seat. In order that as little time as possible be lost in getting away on the return trip the hoist construction makes it possible for the body to lower itself slowly into position for reloading as the truck is moving away.

The dump bodies are fitted with automatic release tail gates which unlock with the operating of the cam release holding

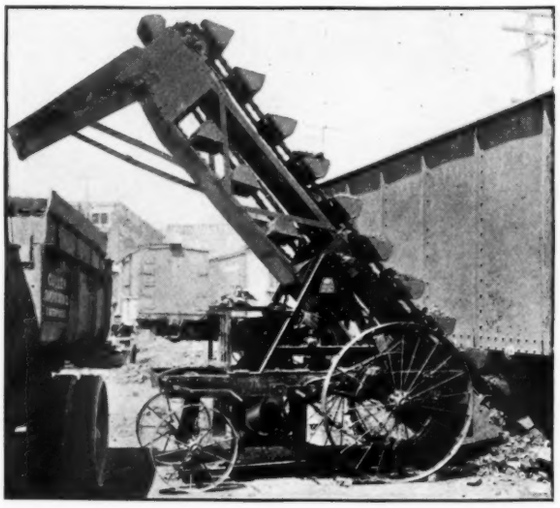
SPECIAL LIGHT WINCH FOR TELEPHONE TRUCK

the body upon the sills.

For loading materials unloaded by dumping there are several equipments on the market. Permanent loading facilities are best taken care of by hoppers—used by large coal merchants—but very often the job is a temporary one and does not justify permanent apparatus.

For loading a truck from a pit or pile there are several equipments: The Haiss path digging, self-feeding wagon loader, made by the George Haiss Mfg. Co., New York City, is one that does away with the majority of manual labor necessary to such loading operators. The Barber-Green Company, Aurora, Illinois, build a self-feeding bucket loader of substantial design, having a capacity of 1 cu. yd. per minute.

For handling granite blocks, large boxes, crates, etc., there is a revolving job crane arrangement. A 1½-ton hoist is mounted on an I-beam track which can swing to one side or



HAISS BUCKET LOADER WORKING ON COAL.

the other of the platform. A concern near Baltimore, Md., has had great satisfaction with an equipment of this kind.

Carting companies who move safes out of upper stories, piano-movers and the like will find our winch equipments of great aid in economically handling their loads. We mount a

Another **FEDERAL**

One to Five Ton Capacities

Saving $6,075 Each Year

Pictured below is the Ottawa, Canada, flusher, mounted on a 3½-ton Federal Truck. This flusher has a 1,000-gallon tank and auxiliary motor. It operates two nine-hour shifts daily, flushing 18 miles of pavement at an average cost of $1.72 per mile.

Mr. A. F. Macallum, Commissioner of Works at Ottawa, Canada, says that this Federal Flusher is saving the city $6,075.00 each year and is doing work formerly accomplished by ten horse-drawn outfits.

This is another instance where Federal's trouble-free, dependable service, under constant, heavy usage, has spelled economy and increased efficiency to its user.

For a haulage unit of honest, dependable, economical service, use a Federal!

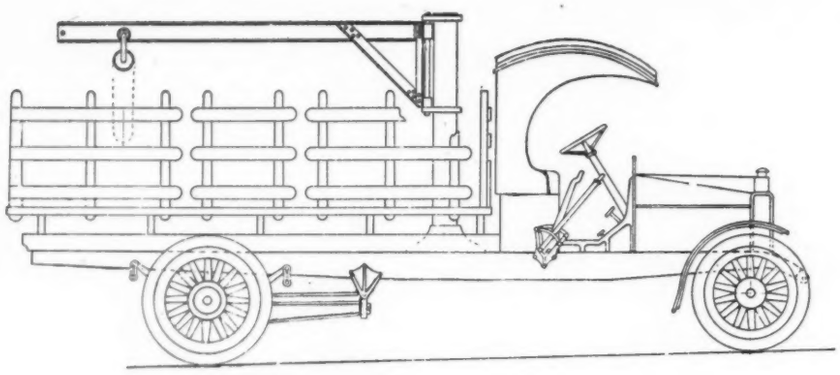
Ask us more about this model.

"Traffic News" mailed monthly on request—free of charge.

FEDERAL MOTOR TRUCK COMPANY
35 FEDERAL STREET DETROIT, MICHIGAN

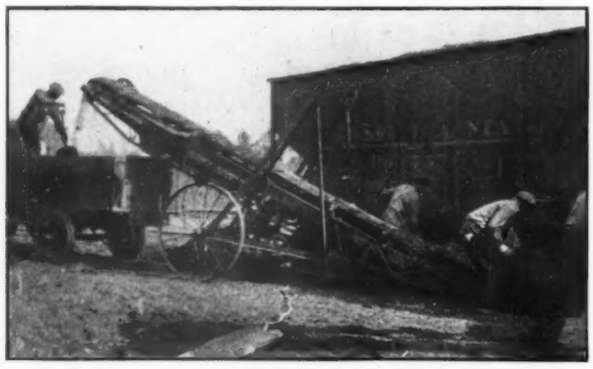
3½-ton Federal Flusher operated by the city of Ottawa, Canada.

"Return Loads will Cut your Haulage Costs"



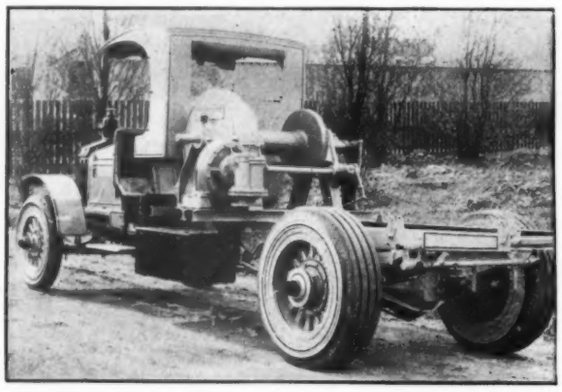
CRANE HOIST MOUNTED ON I-BEAM TRACK

Mead-Morrison Vertical Capstan Winch upon the body platform, winch being braced down to special cross sills. The Pierce-Arrow Light Duty Winch is of great help in telephone line setting and cable laying. This winch, the horizontal type, was designed by our engineers after conferences with Bell telephone engineers and is undoubtedly the most compact and efficient of its type.



PORTABLE BELT CONVEYOR LOADING COAL.

In case a winch of this type but of greater capacity is desired we are in position to mount a heavy duty type manufactured by the Lidgerwood Mfg. Co., of New York City. This winch and the light duty winch are mounted as a unit directly upon the frame, making it a simple matter to remove the entire winch mechanism.



LIDGERWOOD 10,000 POUND WINCH MOUNTED ON TRUCK.

Lumber operatives are learning the value of time in deliveries and several have installed special loading arrangements. For facilitating unloading lumber we have standardized on the Blake Patent Roller in conjunction with our platform body. These rollers are operated by ratchets and handles on the side of the body. Loading time can be reduced considerably using the Blake body in connection with spare bodies, etc. Use of such equipment enabled a Baltimore lumber firm to save $1,344 in nine months on delivery costs.

With the present high cost of labor, reducing the number of men in coal delivering is a most important item. The Thomas Wright Company of Jersey City, N. J., build a horizontal, elevating dump body which can be raised to a position 6 ft. above the standard body height. The advantage of this can be understood when it is found possible to chute coal 30 to 40 ft. This elevating type body is of great aid in loading baskets where that form of delivery is necessary.

The Pierce-Arrow Motor Car Company has had experience in building special bodies for handling malt, hot asphalt and other materials of a particular nature.

SAVE MONEY LABOR TIME

THIS IS WHAT

Heltzel "Lightning" Loader Skips

do in unloading material from open cars.

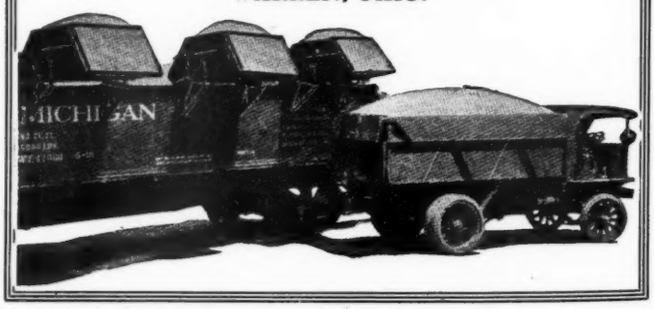
Are **YOU** paying for idle trucks and idle men? Keep your motor trucks moving and your men busy. One **Loader** will pay for itself on the first job.

Made in 1 cu. yd. and 1½ cu. yd. sizes.

Send for Catalog.

Heltzel Steel Form & Iron Co.

WARREN, OHIO.



Reading Advertisements

is just as interesting and just as instructive as reading editorial pages. Advertisements are prepared with the utmost care and contain much information of the highest technical interest and value. Many useful facts and figures first appear in advertisements.

One of the most interesting characteristics of the municipal and county field is the movement of the individual in that field. If he is a county engineer now he may be a city engineer next year, or vice versa. His reading, therefore, should include announcements made either to municipal or county engineers. He may use the knowledge so gained sooner than he thinks likely. Many city and county engineers in quitting public office go into the contracting business. New construction companies are being organized from time to time by former city and county engineers. If, while still engineers, they have read advertisements addressed to contractors they enter the construction field well equipped with knowledge of construction machinery.

The man who would keep abreast of the times can not afford to neglect reading the advertising pages of his business journals. They point the way to efficiency, to economy and often to opportunity.

—The Publisher.

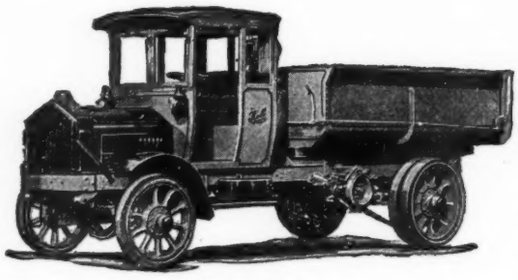
HAUL IT IN A HALL

METAL KNOWLEDGE AND TRUCKS

Makers of **HALL TRUCKS** started business back in 1873—forty-six years ago.

Not making trucks, of course, but fabricating metals—the essentially vital material from which all trucks are made.

And every hour of every work day during nearly a half century they have been literally up to their eyebrows in metals—



A Hall 5-7 Ton Truck

Analyzing, testing, treating, machining, assembling, and manufacturing products composed of iron and steel.

Not slender, delicate metal work, but giant trusses, huge girders, ponderous frames and heavy iron and steel structural elements capable of carrying brute loads and withstanding vicious shocks and unending vibration.

Certainly no maker has greater working knowledge of the basic material going into motor vehicles than the makers of **HALL TRUCKS:**

That a really better truck than the Hall is not made has been demonstrated by years of gruelling service in many lines of industry.

Give the *Hall Dealer* in your territory a chance to demonstrate the true service value of **HALL TRUCKS,** or, write us direct for descriptive literature and complete specifications of all models. *Address Sales Manager, 19 Roby Street, Detroit, Michigan.*

As Manufactured by
The LEWIS-HALL IRON WORKS
DETROIT, MICHIGAN.

EDITORIALS

Is It Wise to Confess Error?

A learned contributor to this issue observes: "It has not seemed to the writer that the importance of a knowledge of failure is sufficiently appreciated. Every one wants to know of a brilliant success, but it is just as important to learn of a failure, so that it may not be repeated."

These are most interesting statements. We can scarcely agree that there is any lack of appreciation of the importance of a knowledge of failures. Every one will admit that it is wise to learn from the mistakes of others, but how are we to do it? Engineering journals get themselves very cordially disliked when they attempt to advance knowledge by describing the failures of men and materials. The purest of motives is likely to be misunderstood when one attempts this journalistic enterprise. Any editor who would make it a part of his business to search out failures would soon incur the displeasure of so many people that his usefulness would be destroyed. The fear of doing injustice often stays the editor's hand.

Confessions of error must come from the one who made the error, if they are to be given out at all. This leads to the query: Is it wise to confess error? Can an engineer afford to make public the lessons he has learned from his failures?

Men naturally hesitate to admit that they have made mistakes. They fear that public confession of error entails loss of prestige. We believe that a man who is generally successful can safely tell of his occasional mistakes, especially if he goes back far enough to speak of himself as a "young" engineer.

But among engineers we find such a degree of caution that many fear even to describe their successes, lest under the cold scrutiny of their professional brethren these successes turn out to be failures at some point or in some particular. Are engineers really so critical? We doubt it.

But where engineers are so reluctant to break out in print, even to describe their successes, the difficulty of getting them to describe their failures can be appreciated.

Some years ago one bold spirit decided to describe some of the failures he had made as a water works engineer. His article was most instructive. No article published that year called out more letters of appreciation than his. A few other articles were contributed by readers of the first article—and that was all, although the editor grew very enthusiastic about articles of this class and wrote several editorials urging engineers to describe the lessons learned from their failures, for the good of the profession. He argued that an engineer who had finally succeeded in spite of the failures that all men make could safely tell of his earlier failures without loss of prestige. We still remember how much fun a contemporary journal had in holding those editorials up to ridicule.

What happened to the eminent water works engineer who described some of the failures he made when a young engineer? Did he lose the confidence of the public or of his profession? We don't think so. We noticed that when his country went to war and a first-class water works engineer was wanted to design quickly and safely the urgently needed water supply works for the various military cantonments, he was selected as the man best qualified to do the work.

For a Continuing Highway Policy and Personnel.

The wise expenditure of public funds for highway construction can best be insured by the formulation and adoption of well-considered policies which shall remain in effect from year to year, and by the retention in office of highway engineers of demonstrated ability, who shall be left free to carry out these policies. There can be no real continuity of policy or progress where changes are frequently made in entire state highway commissions and in state highway engineers. These changes make for a policy of inaction and vacillation, generally speaking. These "quick turnovers" are most expensive to the public, and arrest where they do not endanger the normal development of the good roads movement.

Just how many of the 48 state highway engineers who were in office on the first of this year are still in office we do not at this moment know. Several changes have been made. The percentage of removals has been disquietingly large. If all these changes have been made in the interest of efficiency, well and good, but in some cases partisan politics has probably dictated the change. This statement is made with all due respect to the gentlemen who have ascended to this high office this year. We are as friendly to the present incumbents in all cases as to their predecessors in office. It is not a matter of individual fortunes with which the public is so much concerned as it is with the smooth running of state highway departments, which clearly requires greater security of tenure of office. There have been too many changes this year. We trust that the engineers now in these offices who enjoy public and professional confidence will remain undisturbed for years to come. They have a right to be set free from the worries of practical politics so they can devote all their time and talents to the difficult and exacting duties of their offices.

The states which have made the greatest successes in state aid highway work are those in which the fewest changes have been made in the state highway engineering organizations. All engineering positions in state highway departments, both for selection and tenure of office, should be based solely on merit. This plan has already been adopted in a number of states and it should be adopted elsewhere. The main reason why it is not in operation in more states is that highway commissions frequently change with the political changes in the state. Many of these commissions, however, are being made continuous by having the term of one of the commissioners expire each year or every second year, thus leaving on the board two or more commissioners who have had previous service. Where this plan has been adopted the highway com-

missions are more likely to continue the engineering force from year to year without change.

Engineers who now see that it is a part of their duty to advise the general public on all matters of an engineering nature will find this subject one offering most attractive educational opportunities.

Progressing Under the Scourge of Epidemics.

Some cities, like some individuals, can progress only under necessity. This is not strange, as the policies of cities are determined by individuals. City officials who are accustomed to look and plan ahead in their private business affairs usually adopt the same attitude toward their public duties. To those who like to be forehanded the suggestion is offered that in matters of an engineering nature affecting the public health it is well to take thought of the future.

This point is brought out with striking force and clarity in the recent report on the filtration of the water supply of the city of Detroit, by R. Winthrop Pratt, the consulting engineer. After recommending filtration, he said: "It is true Detroit is not confronted with any severe sanitary crisis, but to progress only under the scourge of epidemics is not a desirable policy. This has been proved in many cases where cities have undertaken filtration projects without sufficient preliminary investigation and consequently at heavy cost. The logical process of improvement, therefore, and the one pursued in this instance, is to anticipate every possible source of disaster, and to demand the best rather than to be content with that which is passably good. For a moderate cost Detroit can add to its industrial distinction and world-wide repute for civic enterprise, the further priceless boon of an irreproachable water supply. It is in the light of such an opportunity that the project outlined is presented."

It is a pleasure to add that the Detroit officials have chosen to safeguard the health of the people by taking steps to filter the water supply as soon as practicable. They are to be commended for this. A "wait and see" policy would continue present conditions there, exposing the people to the possibility of a water-borne epidemic at any time.

The quotation constitutes a complete argument for health insurance of the kind underwritten by engineers. As a piece of effective engineering writing it merits close study from several viewpoints.

Pavement Experiments, Good and Bad.

Experiments in street pavement work must be made if we are to progress in this important branch of municipal engineering work, but not all the experiments are good. Experiments should be made first on a small scale, advancing slowly from the laboratory to the short service-test roadway. There are many desirable experiments to be made in the combination of paving materials as well as in features of design and construction. All these are good experiments, entirely in the public interest.

A bad pavement experiment is the laying of a large yardage of an untried paving material at public expense. Such experiments begin at the wrong end of experimentation. What should be made the last step is made the first. If such an experiment has an unfortunate ending the cause of street paving receives some undesirable publicity. Such cases have occurred more than once.

Recently a county in a western state constructed 100,000 sq. yds. of a new process pavement without first determining whether it would stand up under traffic. The pavement is said to be rapidly going to pieces. In this case the public officials are being severely criticised for adopting a paving material admitted by its promoters to be still in the early experimental stage of its development.

Watch the Assumptions

Perhaps the greatest folly of which men of science are guilty is to work out to a precision of one-tenth of one percent the answer to a problem in which there is a probable error of, say, fifty percent in one or more of the assumptions made preparatory to the application of the symbols of mathematics. Engineers pride themselves in their skill with mathematics, but they should keep steadily in mind the fact that figures can and do lie in many cases. Whether or not the results of the application of mathematics have any real value depends primarily on the soundness of the preliminary assumptions and to the statement of the problem.

Mathematics is an exact science, it is said, and of pure mathematics this is true. But applied mathematics? That is a different story. The mischief comes in the use of the same symbols in applied as in pure mathematics. This tempts the computer to place too much reliance on the results of a problem involving the use of mathematics, but also involving opinion, the forces of nature, prejudice, and goodness only knows what else.

First and last, a vast amount of bosh has been perpetrated in the language of the mathematician. Examples? Assuredly; here are three of them:

A very eminent scientist, at last accounts still among us, once proved to his entire satisfaction—and in fairness to him, let it be said, to the satisfaction also of other eminent scientists—that an attempt to navigate the air in a heavier-than-air machine was but flying in the face of Providence, attempting the physically impossible, flirting with the hearse. Yet we have seen such machines darken the sky and so have you. One or more of his preliminary assumptions were fallacious, that's all.

At one time every professor of physics in this country could prove by mathematics that it is physically impossible to "curve" a baseball. They could all prove it in just the same way, right on the blackboard in front of the class. But along came a long-fingered gentleman who set three stakes in line and curved the ball around the middle one. This he did for three professors, who then reconsidered their assumptions, and, at length, found a fallacy.

Our final illustration is drawn from the late war, as we desire nothing so much as to be up-to-date. According to the rules of exterior ballistics the maximum angle of fire is 45 degrees for the greatest range. Every student of mechanics has proved it. Yet the 42-cm. guns were tilted to 60 degrees. The projectile thus reached a stratum of rarified air which offered less resistance than that encountered when firing at 45 degrees, so the range with 60-degree firing was much longer than the theoretical range.

Give your attention to the assumptions. Let your assistant do the figuring.

More Engineering on Sewer Inlets

By W. W. Horner, Chief Engineer, Sewers and Paving, Room 300, City Hall, St. Louis, Mo.

Of the accessories to our municipal sewerage systems the most obvious is the ordinary corner inlet, and it is the one which has received the least consideration.

It has long been the custom throughout the country to place a storm water inlet at the low corner of every street block, or in some cities where the grades are flat, to place them in the middle of the block and drain from both corners. In the earlier days these inlets were subject to many modifications,

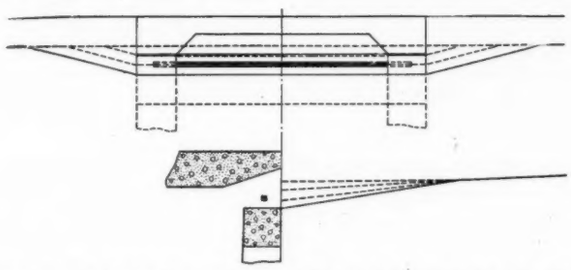


FIG. 1—ELEVATION AND SECTION OF THE ST. LOUIS "OLD STYLE" STORM WATER INLET.
Note: With Each Change of Depth of Sump from Water Line There Is a Corresponding Change in the Stone and Sill.

and as their insufficiencies became apparent to sewerage engineers there gradually evolved a few types of structures, one or all of which may be found in any of our large cities. The commoner type consists of a basin in the sidewalk area to which the water flows through an opening in the face of the curb. The dimensions of this opening vary in different city standards, the height of the opening and the details of the pavement in front vary to some extent, and in some cases the opening is provided with bars to hold out large sized rubbish.

St. Louis Types of Inlets

The St. Louis style is typical of this inlet, known in St. Louis as the "old style" as shown in Fig. 1. It has a clear opening of 4 ft. in length and a face opening of 8 ins. in height, partially obstructed by a horizontal bar, and a net opening of about 5 ins. The outstanding feature of it is the broad sill extending back under the stone cap. About six years ago the deterrent effect of the bar and broad sill on the water seeking to enter the inlet caused the adoption of the "new style standard inlet" in which the face opening is 4½ ft. long, a clear height of 6 ins., the bar is omitted, and the top of the sill is sloped abruptly back from the curb line. In addition to these types, St. Louis has used, somewhat, a cast iron inlet, in some instances having a barred grate flush with the gutter, and in others having also a small curb face opening in addition.

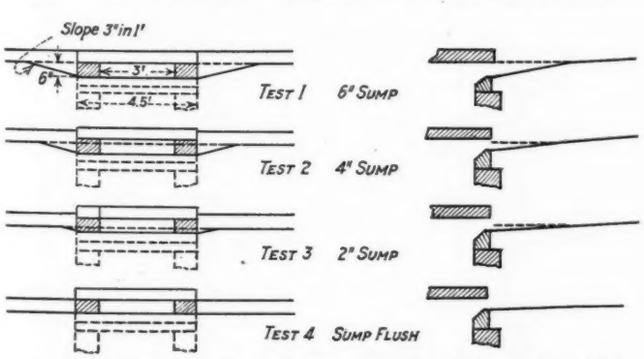


FIG. 2—ST. LOUIS INLET TESTS, SHOWING HOW PAVEMENT WAS RELAID IN FRONT OF INLETS PREPARATORY TO MAKING TESTS.

This inlet, when clean and carrying clean water, compares favorably with the other types, but in the fall of the year, or for streets in which a considerable amount of rubbish is thrown, becomes quickly stopped and is almost useless.

Theoretical Analysis of Intakes

Our sewer engineers have from time to time commented on the failure of all of these types of inlets to catch heavy gutter flows on steep grades, and there has been developed in the last few years a type called the double inlet, with an opening 9 ft. long, and in other respects similar to the new style inlet. This double inlet has arbitrarily been placed on steep grades, and sometimes at other points where large capacities were known to be required. Aside from the arbitrary placing of the double inlet, the inlet work of the St. Louis system involved no real engineering. About four years ago, however, a theoretical analysis of the intakes was made, and the determination was reached that the new style single inlet would not in the future be placed under conditions where it was known that more than 1 cu. ft. per second intake capacity was required.

Tests of Intake Performance

A large amount of research work done by the St. Louis engineers in the past five years, largely in connection with the recomputation of old sewer systems for the purpose of determining necessary reliefs, brough about *a growing consciousness of the extraordinary importance of storm water intakes*, which finally developed to the point that the writer has felt that it is no longer permissible to design a new sewer system, or to design relief sewers for other systems, without careful determination of the ability of the intakes to place water in the storm water sewers at the points where the sewers were designed to receive it. It was, therefore, essential that more actual information on this subject should be obtained, and the tests described below were outlined by the writer, and have been carried out during the past summer by Henry Miller, Junior Engineer of the Division, under the general supervision and co-operation of Guy Brown, in charge of the Section of Sewer Design, and Arthur Keller, First Assistant in that Section.

Objects of Tests

The objects of the tests were to determine the intake capacity of both the old and new style inlets under the various conditions in which they were installed, and to determine the intake capacity of the double inlet under similar conditions.

A general survey indicated that all types of inlets had been

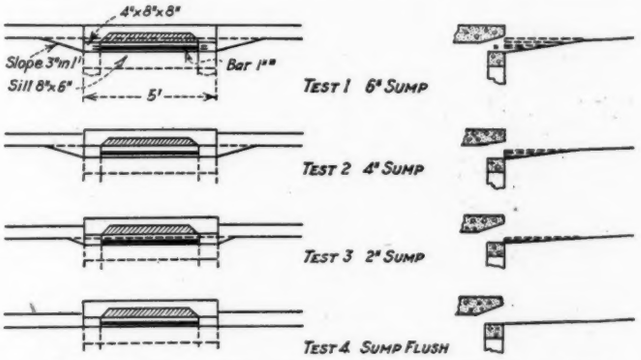


FIG. 3—ST. LOUIS "OLD STYLE" INLET TESTS, SHOWING HOW PAVEMENT WAS RELAID IN FRONT OF INLETS PREPARATORY TO MAKING TESTS.

installed on street grades of from one-fourth per cent. to ten per cent., and that the paving in front of the inlets has been treated with generous disregard of scientific consideration, the extreme variations being from uniform paving with no depressions of sump at the inlet, to a sump as much as 10 ins. deep and of 10 ft. in extent. After some study it became evi-

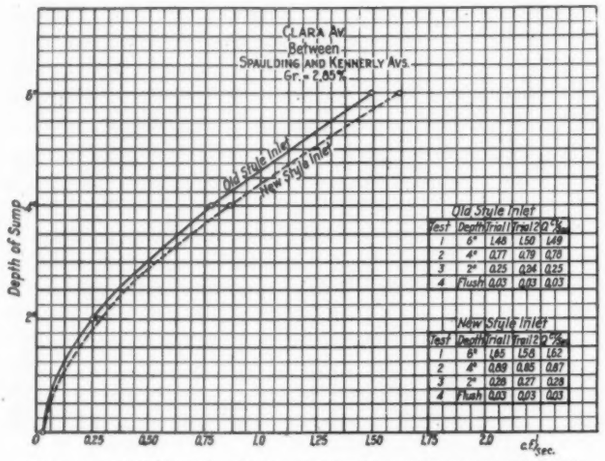

Clara Av.
Between
Spaulding and Kennerly Avs.
Gr. = 2.85%
Old Style Inlet
New Style Inlet
Depth of Sump
c.f./sec.
Old Style Inlet
Test Depth Trial I Trial II Trial III Ave.
1 6" 1.46 1.50 1.49
2 4" 0.77 0.79 0.78
3 2" 0.25 0.24 0.25
4 Flush 0.03 0.03 0.03
New Style Inlet
Test Depth Trial I Trial II Trial III Ave.
1 6" 1.65 1.58 1.62
2 4" 0.89 0.85 0.87
3 2" 0.26 0.27 0.26
4 Flush 0.03 0.03 0.03

FIG. 4—DIAGRAM AND TABLES SHOWING CAPACITIES OF OLD AND NEW STYLE ST. LOUIS INLETS.

dent that this excessive sump was not permissible under modern traffic conditions, and it was decided that the limit of the tests would be for 6 in. depth.

Four locations were chosen to cover the general range of grades, and at a later date another location on a steep grade was added as a check.

In many of the tests the pavement in front of the inlet was carefully relaid, as shown on the sketches in Figs. 2 and 3, in all cases being made parallel to the water line in the gutter, and either flush with it, or a fixed number of inches below it. In the direction of the gutter the slope from the normal water line to the depressed water line was made a constant equal to 3 ins. to the foot. Toward the center of the street the slope was carried out a distance of 3 ft. from the curb.

How Tests Were Made

The water for the tests was supplied from fire plugs through 3 and 4 in. meters in lines of fire hose, four lines of hose being required under the extreme conditions. The water was placed in the gutters a considerable distance above the inlet, and the flow was gradually increased until the inlet was taking its maximum capacity with the water just beginning to lap by. This was recorded as the inlet capacity. The character of the flow in the gutter shows clearly in the accompanying photographs. View B-7 shows a 4 in. sump on a 0.42 per cent. grade, with the capacity of 1.27 cu. ft. per second. B-8 shows the same situation with 3.42 second-feet in the gutter, of which 2.09 is entering the inlet. This contrast indicates that a considerable overcapacity can be obtained after the inlet's real capacity has been passed, which would somewhat alleviate the conditions caused by improperly placed inlets during extreme floods. Photographs C-3 and C-4 show similar conditions for a 2 in. sump, and A-9 and A-10 for the 6 in. sump.

The difference between the capacities of the old and new inlets is brought out clearly on Fig. 4, and was somewhat of a disappointment to the designers of the new style type.

Effect of Depth of Sump on Capacity

On Fig. 5 is shown the effect of the depth of sump on capacity, indicating clearly that with a sump of only 2 ins., less than half of the old value of 1 cu. ft. per second is obtained. This seems to indicate that a sump of 4 to 6 ins. is highly desirable, and should be used unless traffic conditions make it entirely impossible.

Effect of Grade on Capacity

The effect of grade on the capacity is shown in Figure 6, and is probably the most startling result of the test. The converging lines seem to indicate that with the new style single inlet it would be impossible to take in water on grades of over 7 per cent., and that this condition is certainly true for any of the sump depths within the range of this test, and within the range of probability. Tris indicates, therefore, that *for all steep grades a different type of inlet is required*, and an inlet with a long opening like the double inlet described above seems desirable. Tests of the typical double inlet are now being made, and the results, in so far as the 9 ft. length is concerned, will soon be available.

Tests on Detailed Shape and Position of Sump

Other variations on which further tests are being made deal with the detailed shape and position of the sump. Preliminary tests have been made in which the shape of the pavement sump was varied by making one end higher than the other, instead of having it parallel to the water line, as in the test recorded. The most interesting result, however, is in the case where the sump of the lower side of the sump base was moved upstream. This was tried in several positions; the most effective was found when the movement was 2 ft., in which instance the increased capacity varied from 20 to 50 per cent. The reason for this is quite evident in the photographs G-6 and G-11, as compared to conditions on photograph B-7. In the latter case, that is in the symmetrical sump, it is noticed that a hydraulic jump occurs near the low side of the inlet opening, but that the head created by this jump is not effective in forcing the water into the inlet face. With the sump moved

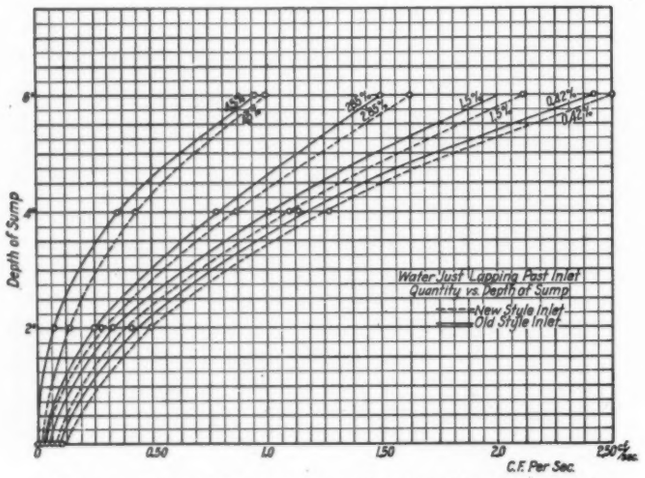


FIG. 5—ST. LOUIS INLET TESTS-DIAGRAM, SHOWING EFFECT OF DEPTH OF SUMP ON INLET CAPACITY.

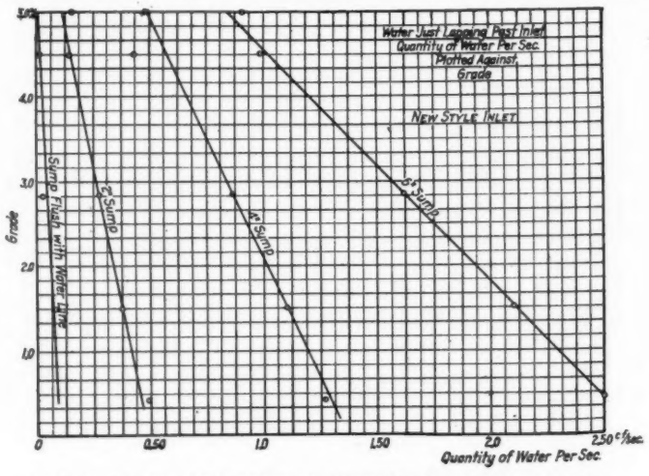
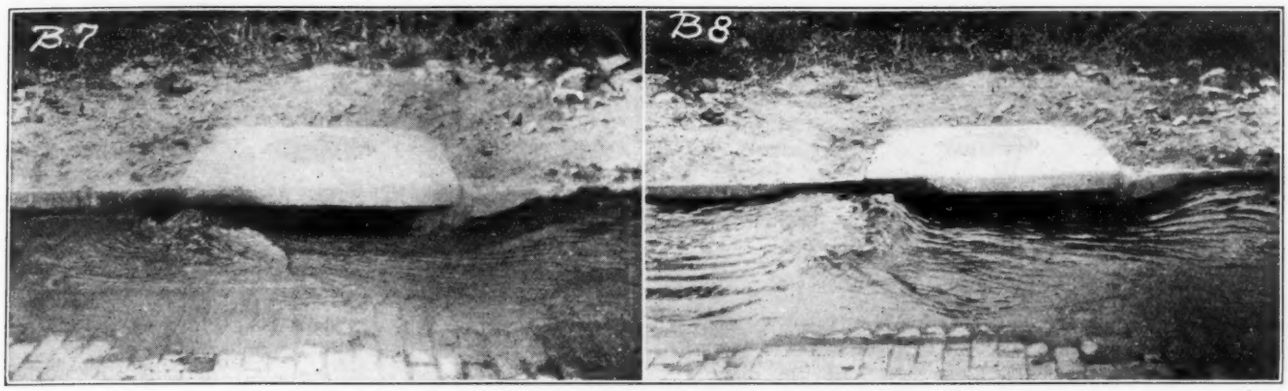


FIG. 6—DIAGRAM SHOWING EFFECT OF GRADE ON CAPACITY OF STORM WATER INLET.



ST. LOUIS STUDIES OF STORM WATER INLET PERFORMANCE.

View B-7 Shows a 4-in. Sump on 0.42% Grade, with Capacity of 1.27 cu. ft. per second. B-8 Shows Same Situation with 3.42 sec.-ft. in Gutter of which 2.09 is entering the Inlet.

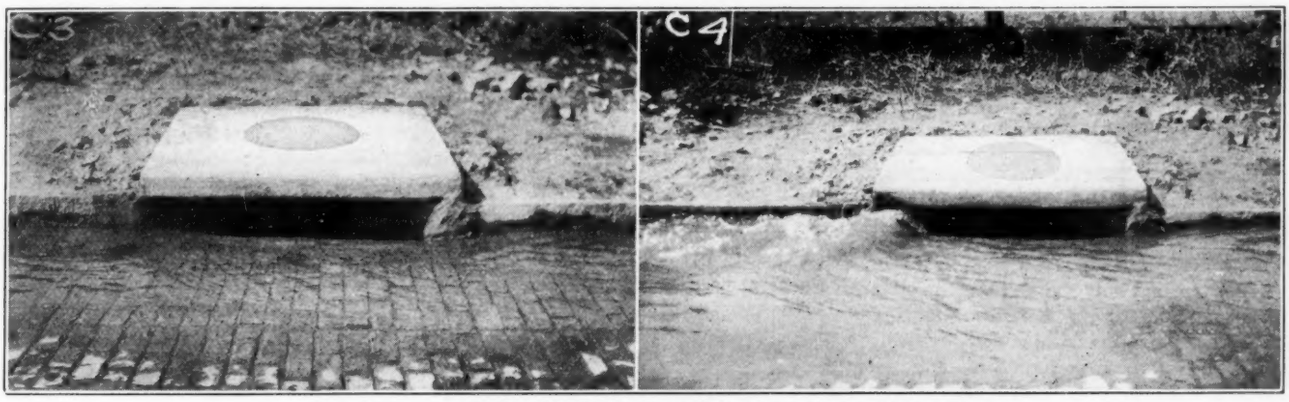
upstream the jump occurs near the center of the inlet, and this head is effective over a considerable area of opening.

Conclusions from Tests

As a result of these tests, the writer has become convinced of the necessity for a scientific determination of the character and spacing of storm water intakes. It is clear that the capacity is dependent on three different factors, the length of the opening, the grade of the street, and the depth of the sump, and also to a considerable degree on the exact shape and position of the sump paving.

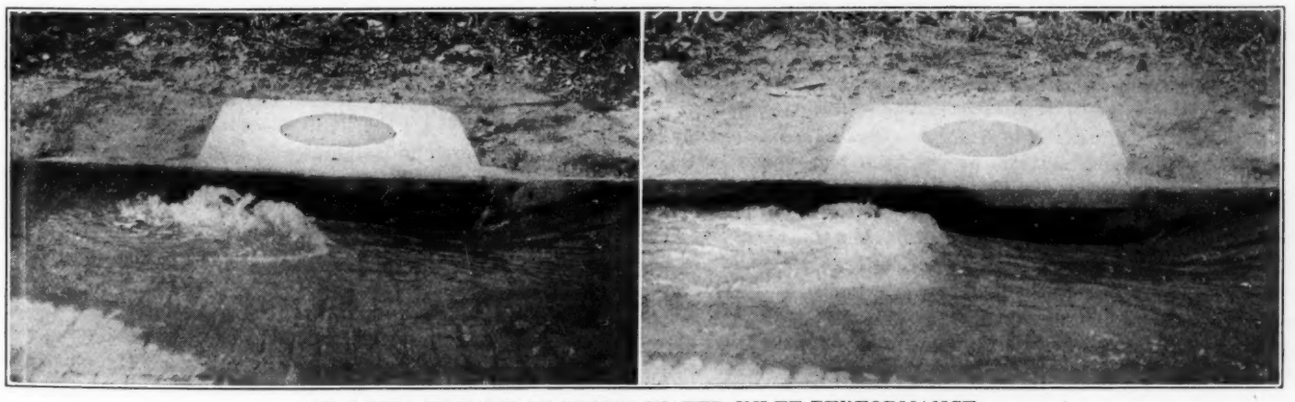
It is intended to work out an ideal shape of paving which will produce the greatest capacity for a given length of inlet, and to work this out for at least two depths of sump, one of which will be permissible under extremely heavy traffic, and a deeper one which will be used under more remote conditions. After determining the type of sump paving possible, the test results taken in connection with the street grades will indicate the maximum spacing of single inlets, and when this spacing becomes uneconomical, double inlets may be assigned at larger intervals.

Scientific inlet detailing and placing by this method will undoubtedly produce some increase in the first cost of the storm water sewer system, but it will make impossible a repetition of conditions which have been observed to be common in our older systems where serious flood congestion and damage has occurred at low pockets in the street grades, at times when even inadequate sewers are not running full. Furthermore, it should be at once evident that careful and rational sewer de-



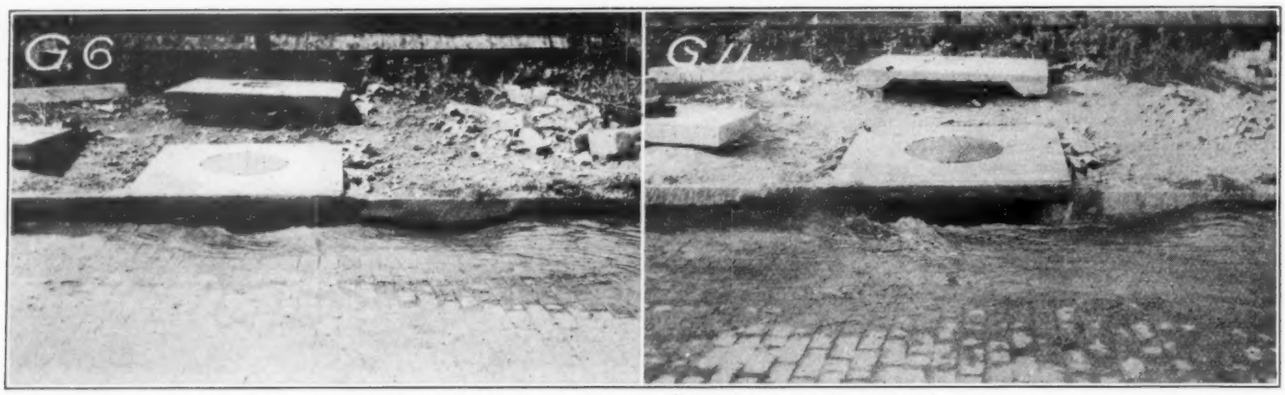
ST. LOUIS STUDIES OF STORM WATER INLET PERFORMANCE.

C-3 Shows a 2-in. Sump on 0.42% Grade with Flow of 0.49 cu. ft. per sec., Water Just Lapping Past. C-4 Shows Same Situation with 3.92 sec.-ft. in Gutter and 1.03 sec.-ft. Entering Inlet (Estimated).



ST. LOUIS STUDIES OF STORM WATER INLET PERFORMANCE.

A-9 Shows a 6-in. Sump on 0.42% Grade With Flow of 2.50 sec.-ft. This Quantity Represents the Amount Inlet Takes Without Appreciable Amount Passing. 10-A Shows Same Situation with 3.62 sec.-ft. in Gutter and 2.90 sec.-ft. Entering (Estimated).



ST. LOUIS STUDIES OF STORM WATER INLET PERFORMANCE.

G-6 Shows a4-in. Sump on a 0.42% Grade With Flow of 1.57 sec.-ft. Downstream Slope Begins at Center of Inlet. G-11 Shows 4-in. Sump on 0.42% Grade With Flow of 1.55 sec.-ft. Downstream Slope Begins at 13½ ins. From Lower End of Inlet.

sign will be accompanied by a large unused value if the water or a large portion of it is to enter the sewer system a block or more further down grade than was expected in the original design. To be more explicit, an under-designed inlet system will result in an apparently over-designed sewer system, with a serious congestion and inadequacy along the lower streets of the district.

The writer is glad to present the accompanying results, because of their immediate value to sewerage engineers. It is expected that the entire series of tests will be completed during the present year, and that they will be the subject for a more exhaustive paper by one of the engineers now actively engaged in the testing.

Some Suggestions for Highway Design

By George W. Tillson, 313 S. Catherine Ave., La Grange, Ill.

Some ten or twelve years ago the writer said in an article on pavements, that the highway and pavement engineers of this country, did their work less scientifically and with less investigation than did engineers of any other class. The statement was disputed, but the writer still believes it was correct at that time. He feels the more free to say this because he was probably one of the worst offenders. Conditions at the present time are different however. For many years a pavement was simply a pavement, constructed of asphalt, brick or stone as the case might be, but generally in the same manner for each particular kind. Very little attempt was made to study the special needs of the different streets but only enough to determine the kind of wearing surface. This hit or miss method was more successful than might have been expected on account of the many changes in the conditions of the streets of our rapidly growing cities.

When the different states started on their regular highway programs and when it was seen how the water-bound macadam failed under motor driven traffic, the necessity of complete investigation became apparent and the highway engineers rose to the occasion.

Connecting State Systems

The fact that each state is proposing a big system of improved roads emphasizes the idea that each state system should be laid out not only to conform to the needs of each individual state but also so that it would form a part of a great national system covering the whole country. The organization of state highway officials bringing together state commissioners and engineers makes it very easy to effect the necessary combination of the systems. These officials, meeting as they do, discuss their own and their neighbors' problems and so add much to the general knowledge, each taking advantage of the others' failures as well as successes. It has not seemed to the writer that the importance of a knowledge of failures was sufficiently appreciated. Everyone wants to know of a brilliant success but it is just as important to learn of a failure so that it may not be repeated. The exchange of ideas at the different conventions permits this to be done.

Grades

After the alignment of the different highways has been established the question of grades must be settled. This is more important on a combined than on an individual system, as on a through inter-state route the ruling grades should be the same when possible. These, too, should be governed by character of the traffic to be provided for. In these days when motor trucks are run regularly from Canton, O., to Boston, Mass., the factor of grades is particularly important.

Foundations

It has always been understood by engineers that a good foundation is required for any construction. It is especially true of highways. To have a good foundation for a road thorough draining is necessary. How these two facts have been appreciated by French highway engineers can be seen from the fact that when the American Commission of Engineers conferred with the French engineers in Paris last December, upon the matter of reconstructing the roads of France the Americans were told that foundation and drainage need not be considered as they had both been sufficiently provided for in the original construction. This, too, was long before the time of motor vehicles. But as the highway systems of this country are generally made up of new roads these two matters require very careful attention.

The writer had an opportunity some two or three years ago of examining the brick roads in the vicinity of Cleveland. Quite a number of cracks in the brick surface was observed, but in almost every instance they were where the roadway was not properly drained.

Width

The width too of the paved roadway is an important question to be settled and only after a careful investigation. In fact, the ruling grade, the width of roadway and character of the pavement must not be determined till after a full and complete census of the traffic has been taken. It may be said that the above are fundamental and well known facts. While this may be so they are so important that they cannot be too strongly dealt with.

Character of Traffic

A traffic investigation is not as simple as it may seem. It is easy enough to count the number of vehicles passing over a road in a given time and approximating their weight, find the traffic tonnage. But that is not sufficient. It will be readily recognized that a roadway might fail under one 10-ton load where it would be perfectly satisfactory under ten 1-ton trucks. But the traffic tonnage would be the same. Then, too, the rate of speed is a factor to be given consideration. When

all the traffic information has been obtained an estimate must be made as to what it will be in the future and provision made for that amount. Then the most important question of all comes up, how to provide for that traffic.

At the present time highway officials have pretty accurate knowledge of all materials that enter into highway construction, such for instance as asphalt, brick, stone, cement, etc. But when it comes to a combination of these different materials they are somewhat at a loss.

Combining Materials

When the character of the traffic is known and the kind of pavement to be used is under consideration much advice is given by the different material men. While not, perhaps, disinterested it is generally honest. Generally speaking the road surfaces now in use are either bituminous, brick or cement concrete. As has been said while we know the different properties of the articles in these roadways it is not known just how to combine them. For instance brick and bituminous pavements are generally laid with a concrete base. To sustain a certain heavy traffic, who knows what should be the different foundations under these materials, or should there be any? Then, too, what should be the character and thickness of a cement concrete surface to equal these other two?

Very few experiments have been made to determine facts that would answer these questions. The English Road Board previous to the war had a machine for this purpose and at the Road Congress held in Detroit in 1913 a somewhat similar machine was shown, but, of course, during the past five years other things have demanded the attention of the world.

Mr. Francis Wood, Borough Engineer of Fulham, London, by observing the wear on wood pavements under known traffic has deduced a method of determining the life of other similar wood pavements when their traffic is known. This determination is made as the result of observation and not by the application of a principle. What is needed is exact knowledge of the conditions that enter into the destruction of a pavement under traffic conditions. That the necessary investigation to determine these conditions should be made by the Bureau of Public Roads at Washington, probably no one will deny. The apparatus which will be required to make all the tests will be expensive but when it is remembered how many millions the government is to contribute during the next few years, the logic of this conclusion will be seen, to say nothing of the weight reports issued from the Bureau of Public Roads will have in the different states.

Specific Tests Recommended

What then are the specific tests to be made? The following are suggested:

Assume a certain traffic (tons per foot of roadway, to be known as heavy) made up principally of 10-ton or heavier trucks and ascertain the kind of construction of the materials heretofore mentioned necessary to sustain it. Ascertain the same facts with the same total tonnage but with lighter traffic units. Make the same experiments with rubber and steel tires at different rates of speed. Also with motor driven and horse drawn vehicles. It would be well to find the difference in results if any when the pavements also are laid on gravel, sand, well drained clay or a natural undrained sub-base.

It must be remembered that in previous tests attrition has been of great importance. With the use of rubber tires on the heaviest trucks a great difference arises and the constant hammer of heavy units upon the road must be given careful consideration; also the effect of the rub or push of the driving wheels of a truck upon the surface of the pavement.

To obtain the above information it must be known if a concrete pavement will fail under the constant hammer of heavy loads or by attrition; whether a brick pavement on a concrete foundation will wear better with a sand cushion or with monolithic construction, also with cement or bituminous joints; how much the wearing surface of asphalt or asphaltic concrete adds to the shock resisting power of a pavement; what the relative values of asphaltic concrete on a concrete base and bituminous macadam are;—whether a concrete base to obtain mass strength should be made thick with a comparatively lean mix or with less thickness but with a better mixture.

The Bureau of Public Roads is at the present time conducting a series of tests somewhat upon the lines herein suggested and some of the results have already been published. These cannot but be of great value to highway engineers. But if detailed results of the action of different forms of construction of the different kinds of pavements in use at the present under the conditions that are bound to arise are known the cost of each kind could be learned and then a scientific determination of the proper one to be used could be made.

Contract for Garbage Disposal by Feeding Awarded by Newark, N. J.

By James W. Costello, Engineering Supervisor, City Hall, Newark, N. J.

A contract for the purchase and final disposition of garbage by feeding as awarded by the City of Newark, N. J., on July 3rd, 1919, for a period of five years commencing September 1st, 1919 to the National Utilization Company, Arthur N. Pierson, president, Woolworth Building, New York City. The price to be paid to the city for each ton of garbage delivered is 8 times the price per pound of live killing hogs on the Chicago market, as determined by averaging the top price for each month.

The site of the piggery is located along the shore of the Passaic River and the City wagons are to deliver all garbage to the feeding site, where it will be weighed. The City agrees to the enforcement of existing ordinances, by orders

NEW SANITARY METAL ASH WAGON COVER WITH FOUR SEPARATE SLIDING COVERS, USED BY CITY OF NEWARK, NEW JERSEY.

or otherwise, to effect a good primary separation, and also agrees to endeavor to pass ordinances whereby the contractor will receive all hotel and restaurant garbage.

The collection of all city refuse was done by contract until 1916, when the contractor terminated the contract on the grounds that the separation ordinance was not enforced. It was then taken over and carried on by municipal forces. There has been some attempt for several years past to separate garbage from other refuse, but it was rather unsuccessful. In March, 1919, a new ordinance was introduced requiring the separation of ashes, rubbish and garbage. At the present time separation is effective in about 50% of the City. A Police Officer and Inspector is assigned to each district to enforce this ordinance, and the results have been very gratifying. Separation in the remainder of the city will be completed about Sept. 15, 1919.

The erection of a reduction plant of 150-ton capacity was contemplated, but in view of the present cost of building ma-

terial it was considered prohibitive, an estimate received from one company being $750,000 exclusive of the site. The city has some 6 square miles of meadow land and all classes of refuse have formerly been dumped on this land. There is a contract for the salvaging of the material for which the city receives $3,000 annually for the privilege, in addition to which the contractor supplies all labor necessary to keep the dumps and the roads leading thereto in good working condition. When separation is completed in the entire city, it is planned to erect a utilization plant for rubbish and when this is realized only ashes will be deposited on the meadow land. The area of the city is 23 square miles and the population is 450,000. It is estimated that 5,000 hogs will be required to consume the maximum amount of garbage during the peak months of summer.

On account of the limited area available at the site of the piggery, intensive methods will be employed. The hogs will be housed in unit buildings 100x100 ft. which will accommodate from 800 to 1,000 hogs. A double concrete driveway and feeding floor 24 ft. wide extends through the center of each building with a gutter on each outer edge next the pens. The gutters discharge into large grease traps to prevent solids reaching the sewer. The pens are arranged on either side of the driveway, having a slight pitch toward the gutters. There are five pens on each side, equipped with an automatic drinking fountain. Each pen opens into a yard 50 ft. deep. The houses are of the saw-tooth type with windows the entire length below the eaves and in the peak.

New Sanitary Metal Ash Wagon Cover

Herewith is a view of our new sanitary metal ash wagon cover. This cover or top has four separate sliding covers, one over each other, and but one-quarter of the top is open while being loaded. The wagon has a capacity of 5 cu. yds. and we now have 50 of these tops on our wagons. The chief advantage of this top is that the load is always covered, dirt and dust does not fly in the face of pedestrians while being loaded, as there is no draft through, and regardless of weather conditions wagons always go to the dump well covered, while with the old canvas cover, under abnormal weather conditions it becomes badly frozen and is very hard to handle and fasten securely and in consequence of this much material rattles off the wagon.

Recommended Procedure in the Design, Construction and Maintenance of Asphalt Macadam Pavements

By Prevost Hubbard, Chemical Engineer, The Asphalt Association, 15 Maiden Lane, New York, N. Y.

Definition

The term asphalt macadam is used to designate a highway having a wearing course of macadam coated and filled with asphalt applied by the penetration method after the broken stone or similar material has been placed on the road. The asphalt macadam pavement is ordinarily laid upon a broken stone foundation but both Telford and concrete foundations may often be used to advantage. Frequently an old existing pavement can be made to serve both as a satisfactory and economical foundation.

Advantages of the Asphalt Macadam

The maximum value of the asphalt macadam for relatively heavy traffic has seldom been developed because of the fact that its foundation has not been properly designed for such traffic. This coupled with careless or unscientific methods of construction have in general placed the pavement upon a lower plane of efficiency than it deserves. Provided careful attention is paid to the details of construction the asphalt macadam will prove not only satisfactory but more economical than many pavements which are classed as higher types.

The first point is well illustrated by sections of asphalt macadam pavement laid some years ago upon a concrete base in Alexandria, Va. During the year 1918 these sections were subjected to excessively heavy motor traffic in connection with the construction and operation of Camp Humphreys. As no railroad was available for transporting the materials of construction everything was carried over these sections, and for many weeks these trucks formed a continuous procession both day and night. Adjacent highways ordinarily classed as higher types were either partly disintegrated or absolutely ruined. The asphalt macadam, however, owing to its very careful construction successfully withstood this traffic except in one or two spots where the foundation was inadequate and the entire structure failed through lack of support.

Throughout the country there exists an enormous mileage of old macadam roads which under present traffic conditions cannot be successfully maintained as such. Bituminous surface treatments are usually depended upon to preserve these roads as long as possible but a time finally arrives when reconstruction or resurfacing becomes necessary. In such case the old broken stone represents a very considerable investment which if practicable should be conserved. The asphalt macadam makes this possible and its selection and use in this connection is often the best solution of the economic problem confronting the engineer. A surprisingly large percentage of existing city pavements are of the macadam type so that the matter is not only of moment to state and county highway engineers but to the municipal engineer as well.

Attention to Details Essential

The purpose of this article is not to present complete specifications for asphalt macadam pavements but to call attention to the important details of construction by suggesting sound methods and to point out faulty practice which should be avoided and which has been responsible for much unsatisfactory work in the past. It has been frequently noted that the best asphalt macadam laid by an engineer or contractor is his first. When this is so it is due to the fact that owing to his lack of familiarity with such work he at first pays careful attention to the details of construction. The work apparently proves to be so simple and the finished pavement so satisfactory that in subsequent jobs he is likely to slight or lose sight of details which he may consider to be of minor importance but which have a great deal to do with the ultimate satisfactory life of the pavement. Neglect of certain of these details may not appear in the newly completed pavement and resulting defects may not develop for a year or more, at which time the true causes will not likely be understood. In order to obtain a pavement which is uniform and will wear uniformly it is necessary that each square yard be constructed as nearly like every other square yard as possible. Owing to the rapidity of asphalt macadam construction the opportunity for variation is so great that too much emphasis cannot be placed upon this fact. The first rule to observe, therefore, is: Construct the asphalt macadam by the square yard and not by the mile.

Foundations.

An existing Macadam or Telford makes an excellent foundation for asphalt macadam pavements provided it is sufficiently thick and well drained to afford adequate support. Too often the thickness of the old road is overestimated. In many cases pavements have been laid on old broken stone roads presumably 6 ins. or more in thickness which in reality averaged but little over 2 ins. of true broken stone. Under such conditions failure of the new pavement is almost sure to follow if subjected to heavy loads when the subgrade is wet. Broken stone foundations for ordinary traffic should seldom be less than 6 ins. thick and for heavy traffic should run from 8 to 12 ins. in thickness. If therefore an old broken stone road is to be utilized as a foundation, test holes should first be dug at frequent intervals to ascertain its true thickness taking

into account the fact that some of the broken stone has been forced into the subgrade. Deficiency in thickness should be remedied by the addition of fresh broken stone which should be thoroughly rolled and filled with screenings to make a finished macadam. The old road should preferably be disturbed as little as possible, but when badly worn into ruts or pot holes or when it is to be materially widened, scarifying, reshaping and bonding with water may be necessary in order to prevent irregularities from showing up in the finished pavement. When the road is not badly out of shape and is of sufficient width and thickness to serve as a foundation existing depressions are best remedied by patching in the usual manner.

Old gravel roads may sometimes be utilized as foundations but gravel carrying a high percentage of clay cannot be depended upon to support heavy loads during the early spring. North of the frost line, or in localities where the subgrade is likely to be wet for considerable periods. Old brick, block and concrete pavements make satisfactory foundations provided all bad depressions are first patched with either hot or cold mix asphaltic concrete.

In the construction of new broken stone foundations it is preferable that the voids should be filled with screenings so as to produce maximum stability. In fact the closer such a foundation approaches the condition of a finished well bonded macadam the more satisfactory will it be. In order to secure this condition it is desirable when conditions permit to complete the foundation considerably in advance of laying the asphalt macadam and to allow it to take traffic until thoroughly seasoned. During such period it should be carefully maintained so that it will have a smooth well bonded surface upon which the pavement proper may be laid.

Under severe subgrade or traffic conditions where the advisability of a slab foundation for other types of pavement is apparent no exception should be made in connection with the asphalt macadam. As the serviceability and economic value of this type become more fully recognized it is quite probable that the use of concrete foundations for asphalt macadam will be more widely adopted for highways subjected to heavy truck traffic.

General Features of Asphalt Macadam Construction

The asphalt macadam is laid upon the prepared foundation in a single course of large size broken stone of about the same dimensions and grade as in ordinary macadam construction. A wider range in types of rock may however be allowed owing to the fact that the natural cementing value of the rock may be ignored. After rolling the layer of coarse stone, hot asphalt cement is applied in such quantity as not merely to cover the surface but to flow into the voids between the stone fragments and thus penetrate the entire wearing course. Application of the asphalt cement may be made either with hand pouring pots or mechanical distributors as later described. After such application the surface voids are filled by spreading and rolling in a thin layer of stone chips. All surplus of stone chips and dust is then broomed off of the surface and a second application or seal coat of asphalt cement is made, covered with stone chips and the pavement completed by rolling.

Spreading and Compacting the Coarse Broken Stone

Before laying the pavement all excess dirt and fine material should be swept from the surface of the foundation. This will not only promote a closer bond between pavement and foundation but will tend to prevent the broken stone from becoming coated with dust and thus interfere with the adhesion of the asphalt cement to the surface of individual fragments. As the completed thickness of the pavement is usually made from 2 to 3 ins. the broken stone should all pass a 2 in. ring. It should consist of sound, durable and angular fragments of uniform quality and should contain no dirt or other objectionable matter occurring either free or as a coating on the stone. If stored in piles along the sides of the road prior to use special precautions should be taken to prevent its becoming mixed with dirt. The fragments should be of as nearly uniform size as possible so as to produce a course of uniform texture, in which, after compaction, the voids are evenly distributed. Wide variations in sizes, particularly running to small sizes, result in the formation of spots which are so dense that uniform penetration of the asphalt will be hindered or entirely prevented. Such spots although not discernable in the newly finished pavement will ravel and disintegrate under traffic long before the pavement has attained its normal life. For this reason the size of broken stone should be carefully inspected as to suitability. For this class of work specifications of the U. S. Bureau of Public Roads require a broken stone product at least 95 per cent. of which will pass a 2 in. laboratory screen and at least 85 per cent. of which will be retained upon a 1 in. screen. In addition the specifications require that from 25 to 75 per cent. of the product shall pass a 1½ in. screen. Except in special cases which require a different method of treatment than here considered the rock should be sufficiently hard to prevent the excessive formation of dust during initial compaction before the first application of asphalt is made. To insure this quality specifications frequently require the rock to show a French coefficient of wear of not less than 7 when subjected to the abrasion test.

The broken stone should be shoveled and not dumped in place upon the foundation. The practice of dumping loads where the stone is required and spreading or flattening out the piles not only results in segregation of fine material thus hindering proper penetration of the asphalt at spots, but also makes it impossible uniformly to compact the wearing course. This is due to the fact that the center of the space originally occupied by each load receives upon dumping an initial compaction much greater than the surrounding area, and ultimate compaction of the entire course leaves such spots slightly higher than the adjacent surface. An uneven bumpy road will therefore be the result. Best practice calls for dumping the stone upon dumping boards from which it is spread by shoveling.

After being spread uniformly over the foundation to the desired thickness, usually about 3 ins. loose, the broken stone should be dry rolled until the fragments have firmly interlocked. A 10 to 12 ton 3-wheel roller is usually satisfactory for this purpose and should be operated exactly as in Macadam Construction. The extent of rolling is a most important consideration and should be carefully watched. If the stone is not thoroughly keyed together before the asphalt cement is applied it is practically impossible properly to consolidate the pavement for heavy traffic; after the asphalt has chilled or set. The result will be a wearing course which will develop waves and ruts in the course of time. On the other hand, if the broken stone is over rolled, dust begins to accumulate on the surface of the fragments and tends to prevent proper adhesion of the asphalt. There is also danger of filling the voids with fine material produced by crushing the larger fragments under the roller and thus preventing uniform penetration of the asphalt. Extreme over-rolling will moreover round the fragments and prevent interlocking. On the whole, however, there exists a general tendency to under roll and much unsatisfactory work in the past is directly responsible to this tendency. If during rolling any surface irregularities appear they should be remedied by loosening the surface and removing or adding coarse stone as may be required. Such places should of course be again compacted to insure uniformity.

Manipulation of The Asphalt Cement

The first application of hot asphalt cement should be made as soon as possible after the coarse broken stone has been compacted. Whether application is made by hand pouring, or by a mechanical distributor there are certain important details which should be closely observed. In the first place no asphalt should be applied unless the entire depth of coarse stone is thoroughly dry and after a rain sufficient time should be

allowed for drying out. The broken stone surface should be clean and uniform in texture and should be free from all ruts, bumps or depressions. For this reason traffic should never be allowed upon the compacted course before the asphalt is applied and any existing irregularities should be remedied before application. This is extremely important in spite of the fact that many surface irregularities may apparently be rolled out after application of the asphalt. Such elimination is more than apt to be but temporary. The initial bond produced by the asphalt is so great that while the stone may be squeezed into depressions it does not become thoroughly compacted at such places, and months later, under concentrated wheel loads, the position of the original ruts and depressions will appear at the surface of the pavement.

Before application the asphalt cement should be heated to a temperature between 275 and 350 degrees F. which will render it sufficiently fluid to penetrate the wearing course before congealing provided the weather is not cold. It is important that heating tanks or kettles be equipped with large stationary thermometers so that the temperature of the asphalt is at all times clearly indicated. If heated above 350 degrees F. for an appreciable length of time the asphalt will harden and may be otherwise injured by coking or burning. If heated lower than 275 degrees F. proper penetration will be hindered or prevented and an excess will remain near the surface and cause bleeding in hot weather. Application of the asphalt should not be made in cold weather and the air temperature at the time of application should preferably be not less than 65 degrees F.

The proper normal consistency of asphalt cement will vary somewhat with climatic and traffic conditions also with the kind of rock which is used. Because of relative ease of application in cool weather a strong tendency exists to use a softer asphalt than is altogether desirable. Such practice is apt to produce a wavy road under concentrated motor traffic. In the asphalt macadam, resistance to downward displacement of the fragments of broken stone is mainly dependent upon their interlocking while the bond produced by the asphalt cement creates sufficient resistance to prevent upward displacement and consequent ravelling.

Horizontal displacement or shoving is prevented mainly by frictional resistance and the use of a very soft asphalt cement materially reduces such resistance. The same effect is produced by the use of an excessive amount of asphalt. The accompanying table will serve as a general guide in selecting suitable ranges of penetration for asphalt cements to be used under various climatic and traffic conditions. These limits are for use when the pavement is constructed of relatively hard, tough rock, such as trap, granite, gneiss and hard limestone. When it is necessary to employ the softer grades of limestone it is not only safe but advisable to use asphalt cement of relatively high penetration although the maximum limit of 150 penetration need seldom be exceeded. An exception to this rule occurs in the case of very soft rock such as the coraline rock of Florida. With such a product very heavy asphaltic oil may safely be used in place of asphalt cement. The reason why softer asphalt cements may be used with the softer grades of limestone lies in the fact that the edges and corners of the fragments grind away under traffic and form dust which amalgamates with the asphalt films to form a tough mastic of higher frictional resistance than the asphalt itself.

Penetration Limits of Asphalt Cement

TRAFFIC	TEMPERATURES		
	Low	Moderate	High
Light	120-150	90-120	80-90
Moderate	90-120	90-120	80-90
Heavy	80-90	80-90	80-90

Uniformity in rate of application of the asphalt cement and its depth of penetration into the pavement are equally important, and should receive just as close attention as the proper porportioning and through combination of concrete. A surplus of asphalt at any point will produce a soft fat spot which will develop into a bump while a deficiency will tend to promote disintegration and ravelling once the seal coat is broken. The proper quantity of asphalt to use for first application on a compacted course 2½ ins. thick is from 1.5 to 1.75 gals. per square yard. Less than 1.5 gals. will not penetrate uniformly for the entire depth and the pavement will not be thoroughly bonded. On the other hand, much in excess of 1.75 gals. will create a surplus which is apt to work to the surface in warm weather and cause bleeding or produce general waviness of the pavement under the shove of heavy traffic. Proper and uniform distribution can only be secured by the use of suitable methods.

Hand Pouring

In spite of the general impression to the contrary excellent results may be obtained by applying the asphalt with hand pouring pots. It is necessary, however, that the pots be properly designed and that at all times the spouts be kept open for their full width. Two types of pots should be used, one with a slotted spout no less than 8 ins. wide and the other with a one-half nozzle. In the former, the slot should be horizontal so that the operator walking directly across the road may carry it in one hand and apply the asphalt for a full width of 8 ins. When pouring, the spout should be kept close to the broken stone surface and never more than 2 or 3 ins. above it. The pot with small nozzle should be used only to touch up spots or narrow strips that may be occasionally missed with the wider spout. Great care should be taken that there is no overlapping but that each strip poured makes a neat joint with the preceding strip.

It is not ordinarily advisable to pour the strips at right angles to the center line of the road as such practice repeated with the seal coat is more than apt to develop a washboardy appearance in the finished road after it has been subjected to traffic. A better method is to pour the asphalt diagonally across the road, and, when seal-coating, to cross the pouring lines of the first application. As an aid to uniform distribution alternating the direction of pouring on each succeeding trip is desirable. Before pouring, the pot should be gaged so that during application it will be emptied on one or two trips across the road. Thus a 3-gal. charge will cover a width 8-ins. wide and 25 ft. long, if applied at the rate of a little over 1.6 gals. per square yard. If the road is, say, 20 ft. wide, the angle of application for a 3-gal. charge is ascertained by measuring off 25 ft. diagonally across the road, from side to side. A constant check should be kept on distances, and until the pourer becomes experienced a string should be stretched to guide each trip. With a little practice the pourer will soon learn to keep the rate of distribution uniform by walking somewhat faster when the pot is full than when it is nearly emptied.

It is advisable to have at least two heating kettles and two pourers on the job. When the layout of the work necessitates emptying the pots across the road from the filling station it is most efficient to locate a kettle on each side of the road slightly in advance of the pouring operation. Especial attention should be paid to having the pots filled each time to the gage marks which have been set.

Mechanical Distribution

Excellent results may be obtained with mechanical distributors, provided they are properly designed and operated. Most of the modern distributors are of heavy construction and large capacity, and apply the heated asphalt under pressure through a set of nozzles set in a frame close to the road surface. As the distributor passes over the course of compacted broken stone before the asphalt reaches the road, it is very important that the load be so distributed that rutting will not occur. Many otherwise well-constructed roads have been seriously injured by rutting, due to the use of a distributor with too narrow tires. This and other general features of importance have

been well covered in specifications adopted in 1917 by the American Society for Municipal Improvements, as follows:

> The pressure distributor employed shall be so designed and operated as to distribute the bituminous materials specified uniformly under a pressure of not less than 20 lbs. nor more than 75 lbs. per sq. in. in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gage so located as to be easily observed by the engineer while walking beside the distributor. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than 6 ft. and so that it will be possible on either side of the machine to apply widths of not more than 2 ft. The distributor shall be provided with wheels having tires, each of which shall not be less than 18 ins. in width, the allowed maximum pressure per sq. in. of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For a 2-ft. diameter wheel, 250 lbs. shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of 20 lbs. per inch being allowed for each additional 3 ins. in diameter.

In operating a mechanical distributor it is very important that applications should not overlap at either the sides or ends and that at the completion of an application the pipes and nozzles should not be allowed to drain onto the road and thus produce fat spots. In some cases it may be helpful to place strips of building paper along the ends and inner edge of a proposed application to prevent overlapping of the asphalt during passage of the distributor. All nozzles should be kept clean and free so as to avoid unnecessary touching up. For covering narrow strips that may have been missed by the distributor a narrow spout pouring pot may be used. Rate of application is controlled by measuring off the distance that the contents of the distributor should cover in a single trip, the width of application being known. The rate of speed of the distributor should then be adjusted so as to just cover this distance during the emptying of the tank when the feed of asphalt to the nozzles is set. Slight adjustments in feed should be made by an experienced operator when variations in rate of speed occur during distribution.

It should be remembered that the covering capacity of a large mechanical distributor is greater than the rolling capacity of a single roller, and the natural desire to use a distributor to its maximum capacity should not be allowed to handicap the construction of the road through under-rolling.

Filling Surface Voids

Immediately after the first application of asphalt has been made, and progressing with it, a thin, uniform layer of small-size broken stone should be spread over the surface in such quantity as to fill the surface voids. The road should then be rolled with the addition of more broken stone if necessary, until the surface is tight and thoroughly bonded.

The size of broken stone used for this purpose is commonly known as ¾-in. Specifications of the U. S. Bureau of Public Roads require at least 95 percent to pass a 1-in. laboratory screen and at least 85 percent to be retained upon a ¼-in. screen. It should be as clean and free from dust as possible and thoroughly dry when applied, or otherwise its bond with the road will be interfered with and this will prevent proper adherence of the seal coat, which is next applied. The same effect will be produced if dust or dirt are allowed to collect upon the surface of the asphalt treatment before the small stone is spread. For this reason the stone should be spread as soon after application of the asphalt as possible.

It should be broadcasted with a wide side swing of the shovel in order to distribute it uniformly in a very thin layer. The use of an excessive amount is not only wasteful, but will result in caking on the surface and in the formation of an excessive amount of stone dust under the roller. After the road has been thoroughly rolled it should be carefully broomed to clean the surface and remove all fine material which is not firmly held in place by the asphalt. The road is then ready for the application of the seal coat.

Application of Seal Coat and Cover

The second application or seal coat of asphalt is made in exactly the same manner as described for the first application except that the quantity is less. From 0.5 to 0.75 gal. per square yard will ordinarily be required, the exact rate being dependent upon the texture of the surface treated. The surface should be uniformly coated but an excess is to be avoided in order to prevent the formation of an unnecessarily thick mat or carpet. The same grade of asphalt should be used as in the first application.

Immediately after the asphalt is applied it should be covered with a uniform layer of small size broken stone such as used after the first application. The road should then be rolled until the surface is smooth and uniform. An excess of cover should be avoided as it will grind up under traffic and overload the seal coat with mineral matter. Such overloading will reduce the life of the seal coat and promote disintegration. In general the amount of cover should be kept to the minimum required to blot up the excess asphalt and prevent it from sticking to the wheels of vehicles. The mat so produced should not exceed a thickness of ½ in. and should preferably be about ⅜ in. The broken stone should be broadcasted over the road so as to make the cover as thin as possible and as rolling progresses additional stone should be spread where its need is indicated.

Maintenance

Ordinary maintenance of a properly designed and properly constructed asphalt macadam pavement will consist only in the rejuvenation of the seal coat or mat or its renewal as it is worn away. Unless traffic is exceedingly heavy or a large amount of dirt has been brought onto the road and ground into the surface no treatment should be necessary for a period of about 5 years. A very light cold surface treatment with road oil at the rate of from 0.2 to 0.25 gal. per square yard, followed by a light cover of stone chips will serve to rejuvenate an old seal coat which has not worn badly or become broken. The use of an excess of such oil should be carefully avoided first because it may soften the underlying asphalt to too great Cover should then be applied in sufficient quantity to blot up will create too thick a mat which is likely to shove under traffic. In no case should the total thickness of the old seal coat and new material exceed ½ in.

As the seal coat protects the underlying road from most of the wear of traffic and at the same time serves as a waterproof blanket it should never be allowed to completely wear out. If perfect adherence to the road surface has been secured and traffic has been uniformly distributed it should wear away very slowly and uniformly until a slightly mosaic surface has developed due to exposure of the upper faces of the coarse stone. As soon as this occurs the seal coat should be renewed. Such renewal may be made by surface treatment with a cut-back asphalt or a very heavy grade of road oil after the road has been carefully swept to remove dust and all loose material. The same general method should be used and the same precautions observed as in the application of the original seal coat. If facilities are at hand it is sometimes advantageous to flush the surface with water after it has been swept in order to cleanse it thoroughly. It should then be allowed to dry out before the new seal coat is applied. Rapid wearing of the seal coat is sometimes due to the use of a soft friable stone for cover. If no better product is available a light dressing of clean sharp sand may prove advisable.

If for any reason breaks or scaling should occur in the seal

coat it should be promptly repaired by thoroughly brooming and cleaning all such weak spots. Cut-back asphalt or a very heavy grade of road oil may then be hand-poured over the exposed surface at a rate not to exceed 0.5 gal. per square yard. Cover should then be applied in sufficient quantity to blot up all excess and bring the patches flush with the surrounding area after rolling or tamping. An excellent method is also to spread and compact a mixture of stone chips and emulsified asphalt over the broken areas. Whatever method is employed of patching the seal coat such work should be done considerably in advance of any general surface treatment in order to allow the patches to season. Otherwise fat spots are apt to develop where the patches have been made.

By properly maintaining the seal coat, breaks or disintegration of the pavement proper will be prevented and the life of the pavement continued indefinitely. If, however, through faulty design or construction breaks occur they should be promptly repaired. When possible the cause of such breaks should first be ascertained in order to apply the proper remedy. Frequently a break in the surface is due to lack of support from below. This may be caused by foundation weakness, poor subgrade or to faulty drainage. Under such conditions it is of course a waste of time and money to repair the pavement without first eliminating the cause of failure. Breaks may, however, also be due to lack of uniformity in distribution of the asphalt throughout the pavement, the presence of unsound stone or to the use of asphalt which has been overheated or burned, during application. Ruts and depressions are either due to lack of support from below, lack of rolling at the proper time during construction, disturbance of the compacted broken stone before the first application of asphalt or to the use of too much or too soft an asphalt. The same is true of bumps and waves. Lack of reasonable uniformity in distribution of the asphalt usually produces both breaks and bumps due in the first instance to lack of binder and in the second to a surplus of binder.

Bumps may sometimes be remedied by cutting them off with a hot shovel but in general patches should be made for both bumps and depressions in the pavement proper. This may be done by cutting out the defective areas so as to produce excavations with approximately vertical sides for the entire thickness of top course. The excavations should then be thoroughly cleaned after which they are filled either with broken stone of the same size and quality as used in original construction with an asphaltic concrete. If the first method is used the stone should be firmly interlocked by tamping after which melted asphalt is hand-poured and the patch finished as described for the original construction of the pavement, seal coat also being applied. In the second case unless facilities are readily available for the use of a hot mix it will be found convenient to patch with a mixture of broken stone and emulsified asphalt.

Emulsified asphalt patching mixtures are usually prepared on a mixing board or platform but sometimes an ordinary concrete batch mixer is used. The mix is proportioned by volume, the proper amount of asphalt being dependent upon the character and grading of the mineral aggregate. Each particle of aggregate should be thoroughly and uniformly coated so as to produce a homogeneous mixture, but an excess of asphalt should be avoided or otherwise the mixture will shove under traffic. The mixing process should be carried only to the point of securing a uniformly coated aggregate as overmixing may cause the emulsion to separate and deposit a film of water on each mineral particle, thus destroying the bond between asphalt and aggregate. If, however, the separation of water is allowed to occur gradually by evaporation after the mixture has been placed the asphalt will adhere firmly to a clean uncoated aggregate.

After the mix has been prepared it should be laid in the clean hole and tamped or rolled flush with the surrounding area. The patch should then be sanded or covered with a light dressing of stone chips, after which it should be allowed to set up for a short while before being subjected to traffic.

For patching shallow ruts and depression a mixture of emulsified asphalt and small-size broken stone is sometimes used without first cutting out a hole. Care should be exercised, if this method is followed, that the old surface is first very thoroughly cleaned. While somewhat more costly, it is safer to cut out the old surface, as concentrated traffic is apt to squeeze the patching mixture out of a depression with cup-shaped or rounded sides.

If the maintenance of an old asphalt macadam pavement has been neglected to the extent that it is so badly broken up or out of shape as to need resurfacing, it should either be removed or scarified and reshaped to form a foundation for a new pavement.

Characteristics of Bitoslag Pavement

By J. R. Draney, Bitoslag Paving Co., 90 West St., New York City

The highway and pavement engineer of the present has problems different from those which confronted engineers of only a few years ago. Then, building a pavement to fulfill heavy traffic conditions meant one which would withstand the abrasion of heavily-shod horses and the weight of so-called heavy loads on narrow steel tires. In those days the steel tire with 2 or 3 or 4 tons in the load was considered quite a menace to a pavement unless the steel band was of a certain minimum width considered necessary to distribute the weight of the load. Now, the problems of the steel tires and heavily shod horses are to a large extent eliminated, and the new problem is the heavy motor vehicles, with weights running four and five times greater than the average heavy load of the past.

It is true that the shock to the pavement with the heavy loads of today is somewhat ameliorated by the use of rubber tires. Nevertheless, this offset is not sufficiently great to equalize conditions.

A pavement designed to meet modern traffic conditions is Bitoslag. The writer, being especially interested and active in the development of this form of pavement, would naturally be considered biased and prejudiced in its favor, and he therefore desires to make it clear that this article is merely intended to convey a description of Bitoslag pavement and the claims that are made for what it accomplishes in practice.

Representative Installations

This pavement, laid to a large extent in many important places, such as Jefferson county, Alabama, adjacent to Birmingham; Fulton county, Georgia, adjacent to Atlanta; Allegheny county, Pennsylvania, adjacent to Pittsburgh; New Castle county, Delaware, adjacent to Wilmington; State Highway of Pennsylvania, adjacent to West Nanticoke, in Luzerne county, and in the cities of Philadelphia, Detroit, South Bend, Mahanoy City and Coatesville, has attracted considerable attention, and it is the writer's purpose to acquaint his readers with intimate detail of its construction and observation under heavy traffic.

As a matter of information it might be stated that in addition to the above-named places, contracts for about 100,000 sq. yds. have been let for Bitoslag in Hamilton county, near Cincinnati. Most of this work is under State Highway Department jurisdiction with Federal aid. The State Highway Department of Rhode Island is also laying some miles of this pavement, and three or four municipalities in northern New Jersey have contracted for it.

Bitoslag is a pavement composed of especially prepared asphalt and finely crushed slag combined with a filler and mixed in regular asphalt paving plants. It is generally laid to a depth of not less than 2 ins. in thickness after compres-

sion. Bitoslag paving cement is an oxidized bitumen compounded with an impalpable powder prepared specifically for the purpose.

It is relatively unaffected by temperature changes because it is low in susceptibility. It is, therefore, considerably harder in warm weather and softer in cold weather than the asphalt cements commonly used in sheet asphalt and asphaltic concrete types of pavements.

When in contact with the broken, crystalline particles of slag this bituminous cement remains as an unchanged cement, binding the particles of broken or crushed slag strongly together. It seems particularly adapted for use with slag.

When the particles of slag are coated with Bitoslag paving cement in the process of heating and mixing together and combined with a filler, the Bitoslag paving cement then penetrates the openings and relatively larger pores of the slag and takes its final and stable position when the pavement is firmly compressed in place on a street or road. The Bitoslag paving cement also remains as a matrix, or coating, between the pieces of broken slag, firmly binding them together.

Where the slag is slightly deficient in certain fine asphalts, sand is used in conjunction with the limestone dust filler or Portland cement filler.

In the process of mixing it is necessary to keep the temperature at a minimum of 325, as Bitoslag should arrive on the work at a temperature of not less than 300 degrees. The mixture is spread and raked on the roadway in the same manner as sheet asphalt or asphaltic concrete. However, it should be promptly rolled, as the mixture "sets up" or cools very quickly.

A strong individual characteristic of and recommendation for Bitoslag is the fact that traffic can be sent over it immediately after rolling. Bitoslag presents a slightly roughened and gritty surface, thereby affording a good foothold for horses and machines. So far, under the very heaviest kind of traffic it has shown no tendency to creep, roll, push or shove, nor has there been any evidence of ruts. Likewise, there is no tendency toward cracking.

A sightly, smooth-riding, durable pavement, capable of taking care of the most extreme traffic conditions, is the aim of the Bitoslag proposition, with the cost within reason. Whether these aspirations have been realized is left to the good judgment of those who have had the opportunity of observing the pavement in use under all conditions of traffic and weather.

Correction to "Some Broader Aspects of Rain Intensity in Relation to Storm Sewer Design"

The following paragraphs were accidentally omitted in the publication of the article bearing the above title in the June issue of Municipal and County Engineering. They should be inserted on page 220, following table No. 1:

Excessive rain intensities of such short duration are nearly always the result of thunderstorms.

Thunderstorms also commonly occur in conjunction with such general cyclonic storms as produce the highest rain intensities for longer durations, so that there is a close correlation between thunderstorm frequency and the frequency of high rain intensities of all durations.

Table No. 1, compiled by Mr. W. H. Alexander of the U. S. Weather Bureau, shows for a number of selected stations the large proportion of rains of excessive intensity which occurred with thunderstorms. In this table the rains counted as of excessive intensity are those classified in accordance with the U. S. Weather Bureau Scale and the number of thunderstorms per year represents the number of storms in which thunder was distinctly audible at the observation station. In a general way the proportion of excessive rains which occur in conjunction with thunderstorms increases with the altitude, and with the frequency of thunderstorms at a given station.

Meyer has compiled data for 100 rain storms of notable intensity, which have occurred at 43 stations east of the Rockies in the period 1896-1914. Grouping together stations for which the intensities of a given frequency are about equal, he obtains final groups of average intensities for various durations and recurrence intervals.

The characteristics of Meyer's groups are as follows:

Group	No. Cities	Locality	5 minute intensity of 1 year frequency
1	3	Gulf Coast	5.28
2	15	Southeast States	4.32
3	19	Northeast States	3.84
4	4	Great Lakes	3.12
5	2	Northwest	3.00

Considerations Affecting the Choice of Highway Culvert Materials in Oklahoma

By Max L. Cunningham, State Engineer, Capitol Bldg., Oklahoma City, Okla.

Construction conditions in Oklahoma have, in common with other States, been extremely difficult during the past two years, and, in fact, ever since the organization of the present State Highway Department in May, 1916. Prices and conditions have never been normal and the enforcement of new, and generally unpopular, laws has been a difficult matter.

The special session of the Legislature in 1916 gave the department wide advisory powers, but it has not been possible to enforce all things as we would wish, owing to lack of teeth in the law, which planned good things, but provided few ways to see that they were carried out.

The power is given the department to approve different types of material for the construction of openings with area less than 36 sq. ft., but owing to the defect above mentioned this matter has been handled with gloves, and only such work as comes within the special provisions of the laws (concrete or stone) is approved unless it is certain that the work will be built in the manner approved by the department.

Where it has been deemed advisable, small openings have been built of the material most satisfactory under existing field and transportation conditions. In the mountainous country in the southeast part of the State, where the streams flow so rapidly that there is no sand deposited for use in concrete and where distances and grades are both great, extensive use has been made of corrugated metal pipe in diameters up to 4 ft. It has been an almost universal rule under these conditions to build culvert heads of rubble concrete or range masonry.

Where transportation is expensive, as in the oil fields, and where there are no local materials available, small openings have been built of vitrified pipe in sizes up to 24 ins. and of segmental vitrified tile for openings as great as 6 ft. inside diameter. Both materials have been entirely satisfactory and distinct economies have been obtained by their use. Headwalls are invariably built and local materials used wherever possible, but we have been successful in the use of hollow tile blocks with square or slanted ends, used to build culvert ends where the segmental blocks are used in the body of the opening.

Concrete and stone are used where the material can be secured locally or at reasonable cost, but the transportation situation has been such for the past two years that it has been absolutely impossible to make any definite figures on cars and work has been badly handicapped.

Very little use has been made of the patented cast iron pipe offered by some manufacturers, because of the cost and because of the great difficulty in getting average road officials to install it properly. No cast iron water pipe has been used because of the fact that other materials could invariably be installed for much less money than this under prevailing prices for pig iron.

It is impossible to give an accurate idea of the comparative cost of culverts of different materials, because nearly every piece of work we handle is done by contract (and where this is not the case, it ought to be), and local conditions govern the prices in nearly every case, so that there can be no reasonable basis for comparison. Prices of teams have varied from $4 to $16 per 8-hour day, labor has run from 30 cts. to 90 cts. per hour, and both teams and labor have been unsatisfactory, as is usually the case when high wages prevail. Cement has advanced by several arbitrary jumps, and the less said about freight rates and conditions, the better. Estimates have been made and checked carefully, and it is safe to say that contractors have averaged 15 per cent. paper profit on their work, but in many cases the overhead charges have caused these small jobs to show losses. Holding men while you wait for material has been expensive.

Concrete pipe has been used very little, not because we do not approve it, but nobody manufactures it, and the only place where any considerable use was made of it the contractor did not do well because of bad road conditions and expense of transportation from his central yard.

We feel that we have been very fortunate in keeping on the move at all, and our prospects for the future are apparently much brighter, as we have developed a resourceful organization, have discovered and made use of many sources of supply that we did not dream of using before we were pinched, and are much better able to meet difficult conditions than ever before.

Arguments Favoring National System of Improved Highways, Constructed, Maintained and Financed with Federal Funds

By M. O. Eldridge, Director of Roads, American Automobile Association, Riggs Bldg., Washington, D. C.

Many thousands of thoughtful citizens now believe that a national system of roads, constructed, maintained, and paid for by the federal government, is an urgent need of our country today and second to no other thing. Such a system has been advocated by far-visioned statesmen from the early days of the republic up to the present time.

Our present commercial, social and military needs call for roads which cross and recross state lines, for traffic does not begin nor end at state boundaries. The character and condition of highways in a neighboring state are often of as much importance to a road user as the arteries of communication in his own state, county or community. A comprehensive system of highways selected by federal and state authorities and a program of construction and maintenance such as could be carried out under federal control would insure a higher standard of road building and repair than is possible under the present federal aid plan, said Mr. Eldridge in addressing the North Carolina Roads Association recently.

Shortcomings Inherent in Present Federal Aid Plan

Under the present plan, by reason of the fact that the initiative rests with the states in selection not only of the individual project, but the type of construction also, there can be no uniformly high standard of durable types of highways. The varying degree of financial ability on the part of the several states, the conceptions of legislators, officials, and the people as to the extent to which the federal funds should be distributed, and the difference in judgment among the 48 state engineers and the thousands of local engineers, make impossible any real consistency in construction. Thus on the same highway carrying heavy traffic, one may find concrete, brick, bituminous macadam, or other high type, extending to a state line and then suddenly dropping off to light gravel construction or even earth, because the next commonwealth was either unable or unwilling to meet this standard.

Of the 10,445 miles of federal aid projects approved up to a recent date, the distribution by types was as follows:

Types	Miles	Per cent. of Total.
Earth	3,223	30.9
Sand-clay	1,533	14.7
Gravel	3,167	30,3
Water-bound Macadam	462	4.4
All other types	2,060	19.7
	10,445	100

Forty-five per cent. of the roads approved at the time this statement was prepared were of light construction, more or less temporary in character. Seventy-five per cent. were of a type lighter than water-bound macadam, while only 20 per cent. of the roads were of a type which should be used on a State federal system, where present day and prospective traffic requires in most cases something better than earth, sand-clay, gravel, or even water-bound macadam. These figures tell the discouraging story.

It should be stated, however, in justice to our state and federal highway authorities that the legislatures and the people in many states insist that federal and state funds shall be spread out yearly so that each county will obtain a "small slice of the pie," thus perpetuating the practice of patching and make-shift construction for purely local purposes. In those states in which a short-sighted policy prevails, it will be impossible for state and federal authorities to accomplish anything other than the building of roads that meet merely local needs.

Modern traffic requires that main routes be wide, that dangerous curves and railroad crossings be eliminated, that substantial bridges be built, that road surfaces be durable, and that they be systematically maintained. In building detached individual projects, as often is the case under the present federal aid act, the accomplishment of those purposes is difficult, and in many cases impossible. For example, if a federal aid project is two miles in length and is located on an important ten miles of highway, it betters the situation very little to widen the road, cover it with hard surface and keep it in good repair for the two miles and leave it untouched for the other eight miles. In many of the states the law provides supervision of the highways of the state, while the bridges are under care of the counties, and in some states, complete jurisdiction over both roads and bridges is vested in county authorities. This, of course, renders unified control in such state out of the question.

The day of the individual road, except as feeders to trunk lines and market roads, has passed. Highway improvements must be continuous and coordinated, and the federal government should not encourage the continual individualizing of the highway improvements through confining its efforts to the granting of aid to the individual highway, which does not constitute a part of a well conceived system that justifies National consideration.

The Townsend Bill

The Townsend bill now before Congress calls for a national system of highways which will meet our present and future needs. The bill provides that the government shall take over, with the consent of the states, not less than 2 per cent. nor more than 4 per cent. of the most important highways of the country, selected by state and federal authorities with this system constructed and maintained by the government at government expense. That such a system can be kept within 3 per cent. of the total road mileage in the United States and still serve our greatest needs, has been definitely established by careful research.

To make the point clear, it may safely be stated that a zone 10 miles in width and 25,000 miles in length will reach more than 86 per cent. of the population of the United States, more than 85 per cent. of the taxable real estate, and more

than 55 per cent. of the tonnage of farm products. Such a system would include possible military roads having an aggregate of about 10,800 miles; serve our Atlantic, Gulf, and Pacific Coast lines, and also cover our Mexican and Canadian borders; would give access to our national forests and national parks and open up much of the public domain not now easily accessible, besides affording trunk line routes for parcels post in the territories where this form of transportion is needed. It would also include adequate links in the national system in every state.

If, as a condition to the building of the national highways in each state, a construction of an equivalent mileage of state highways should be required, this would add 75,000 miles of state highways, which with the national system, would aggregate 150,000 miles of main trunk lines. With this double system, practically all of the 1,400 cities and towns of 5,000 population and over would be on the main system, as well as every Atlantic, Pacific, Gulf, and lake port. It would be possible to achieve at the same time a superb military system connecting every important fort and concentration point, arsenal and munitions center throughout the U. S. while meeting industrial needs so completely that less than 5 per cent. of the population and the taxable values, and less than 15 per cent. of the tonnage of farm products would be more than five miles away from this joint national and state system.

It needs no profound statistical manipulations to demonstrate these points, for it can easily be understood that 150,000 miles of highways, with a zone extending for 5 miles on each side, would serve 1,500,000 square miles of area or approximately half of the total area of the United States.

The task of building the national system is well within the means of the nation, and it is the duty of all good Americans to rally to the support of Senator Townsend's bill.

An Engineer Comments on the Labor Question

By H. W. Skidmore, Chicago Paving Laboratory, 160 North Wells St., Chicago, Ill.

Notwithstanding the fact that organized labor is being extensively lauded by high officials of the American Federation of Labor, strikes, walkouts and lockouts still seem to be quite prevalent.

We are being constantly reminded of the fact that the ideals and principles of organized labor are of sterling American quality. Labor officials are making much talk concerning the exalted patriotism displayed by the worker during the war period, and the public is assured, by the words of these same officials, that organized labor is prepared to meet every emergency created by the transition from war to peace. Labor is pictured as the savior of democracy from the blight of radicalism. In the light of careful analysis of the situation, it does not seem reasonable that any one group, even though it be highly organized, is entirely justified in acclaiming it is the chief protector of American democracy.

Organized labor is one result of true democratic government. Under our Constitution, men and groups of men are permitted to think and act as they see fit, to protect and promote their interests individually and collectively, just as long as their acts do not jeopardize the rights of others.

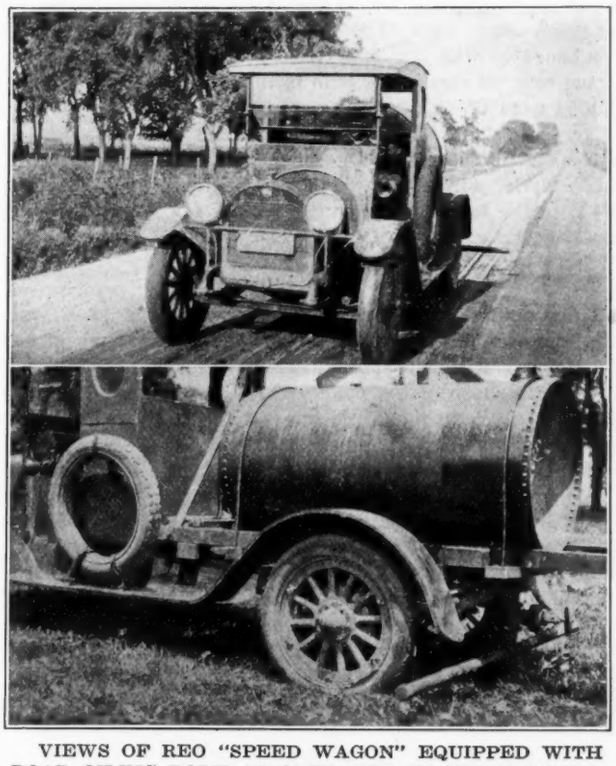
The labor unions of this country should be American institutions, founded on true American principles; to be otherwise would certainly be to their discredit. If they be in true accord with these principles, surely that fact will speak for itself, without any special advertising campaign. While a reasonable amount of praise of one's own goods is oftentimes necessary and ordinarily commendable, there is great danger in overdoing a good thing. If the song seems unnecessarily loud, and the singing a bit too frequent, the public mind is apt to become apprehensive, and may begin to search for the reason back of such a sudden outburst of self-advertisement. Moreover, in order to avoid being classed among the idle boasters, the singer sometimes finds himself in the uncomfortable position of being required to "deliver the goods."

General strikes, street car strikes, milk wagon drivers' strikes, telegraphers' strikes, and the like, with refusal to arbitrate, violence and threats, lack a considerable amount of measuring up to the American idea of patriotism, justice, charity and consideration for the rights of others. When the public is no longer confronted with such frequent examples as these, then, and only then, will it be in position to accept at their face value these declarations of high-up labor leaders regarding the thoroughness with which organized labor is grounded in the fundamental principles of American democracy.

Enterprising Farmers and Township Road Commissioners Co-operate in Economical Road Oiling

Two farmers, Lewis Dixon and W. D. Shelton, of Dalton City, Ill., recently co-operated with the road commissioners of Milan Township, Macon County, in distributing oil on the public roads. These farmers each own and operate a Reo "Speed Wagon" on their farms for general farm hauling. For this purpose the trucks are equipped with farm dump bodies.

The farmers contracted to distribute oil on the roads for 1 cent per gallon. They removed the farm dump bodies and used instead gravity feed oil tanks of 350 gals. capacity, equipped with oil spray pipes that cover 8 ft. 6 ins. This oiling equipment is manufactured by the Leader Iron Works of Decatur and retails at $121 f. o. b. Decatur. The cost of the Reo chassis is $1,285.



VIEWS OF REO "SPEED WAGON" EQUIPPED WITH ROAD OILING BODY AS OPERATED IN MILAN TOWNSHIP, MACON COUNTY, ILL.

With these two Reo "Speed Wagons," equipped as described the farmers twice oiled 9½ miles of road in 2½ days. Twelve 350 gal. loads were distributed per mile. The average haul was 3 miles. A total of 4,260 gals. were distributed on each

mile of the 9½ miles of road. For this the farmers received 1 cent per gallon, or a total of $404.70 in 2½ days.

These figures clearly indicate that money is quickly made in the operation of these oiling units. The oiling equipment is easily and quickly removed when the truck chassis is wanted for other than oiling purposes. This light truck readily lends itself to a variety of uses in county and township road work.

Road Contracts Being Completed in Kansas Refute False Statements About Highway Costs

The following illuminating article is reprinted in full from the August number of *Kansas Highways*, the official organ of the Kansas State Highway Commission:

When Kansas people began to get up petitions for the improvement of roads under the benefits district plan the dove of peace was hovering over us and building material and labor costs were in a normal condition.

Since then everything has become abnormal, but despite this fact, road costs have not been as great as the enemies of road building would have you believe. This talk of "taking a man's farm," of "placing a mortgage of $2,500 on every quarter section of land," and other like expressions, are not borne out by the facts as proven by projects now under construction.

A Concrete Road

Shawnee county is constructing a concrete road 18 ft. wide from Topeka east to the Douglas county line. This is approximately 10 miles in length. A citizen of Shawnee county living outside the benefit district and townships interested, will pay 12 cts. a thousand for 20 years as his portion of the county's share of the road improvement. On the township's share each $1,000 worth of property in the townships benefited will pay 38½ cts. a year for 20 years, and the average cost an acre to the land in the benefit district, interest included is $4.17. Hence a man in Shawnee county who owns 160 acres of land in the benefit district and pays his apportionment in 20 annual installments, all his taxable property being $10,000, will pay toward the construction of this concrete road the following amounts: county tax, $1.20; township tax, $3.85; benefit district tax, $33.36; thus making a total of $38.41 a year.

A Brick Road

Reno county has a contract for a brick road 18 ft. wide and 7.09 miles in length. A thousand dollars' worth of taxable property will pay approximately 18½ cts. a year for 20 years as its share of the county tax. The same $1,000 also pays 85 cts. a year, including interest for 20 years if it is in one of the townships in the benefit district.

The land in the benefit district will pay $4.71 an acre a year, interest included, for 20 years as the benefit district tax. In other words, if a man in Reno county owns 160 acres of land in a benefit district and pays his apportionment in 20 annual installments, all his taxable property being $10,000, he will pay toward the construction of this brick road: county tax, $1.85; township tax, $8.50; benefit district tax, $35.15; making a total of $45.50 a year.

A Gravel Road

Labette county is constructing a gravel road 16 ft. wide which has a total length of 9.14 miles. A thousand dollars' worth of taxable property will pay 60 cts. a year for 10 years as its share of the county tax. The same thousand dollars also pays 25.4 cents a year for 10 years as its share of the township tax. The land in the benefit district will pay $1.16 an acre a year, interest included, for 10 years as the benefit district tax. A tax payer in Labette county who owns 160 acres of land in the benefit district, and pays his apportionment in 10 annual installments, and all his taxable property is assessed for $10,000, will pay toward the construction of this gravel road: county tax, $0.60; township tax, $2.54; benefit district tax, $18.56; making a total of $21.70 a year.

It must be borne in mind that, in each one of these examples we have given, the figures are arrived at from contracts actually let and from reports of roads under construction. In each case government aid on a basis of 50 percent, not exceeding $15,000 a mile, has been included.

These figures are a matter of record in each county referred to. It is therefore, as we mentioned before, certainly difficult to understand the motive of those who are loudly proclaiming that the cost of road improvements will equal $2,300 to $3,500 a quarter section and in some instances it would be equivalent to a confiscation of property.

It is true that in some counties petitions were signed before the war by those eligible in the benefit districts, believing that the cost would not exceed $18,000 to $20,000 a mile. Those were the average costs in other states at the time those petitions were circulated, but costs of every kind have advanced greatly since then, and no one in his right mind can justly accuse those who circulated petitions of practicing deception.

However, it also must be remembered that those petitions were signed with the understanding that Federal aid would be 15 per cent., and now it has been advanced to 50 per cent.

Likewise, the man who pays the largest tax for road improvement; that is, the man who lives next to the road, is marketing his products, whether grain, hay, cattle or hogs, for a much greater per cent. of increase than the per cent. of increase in the cost of road construction, in view of the greatly increased Federal aid.

Building Construction a Gamble Except Under the Cost-Plus-Fixed-Fee Contract

By A. E. Wells, President Wells Brothers Construction Co., 914 Monadnock Block, Chicago, Ill.

If a half dozen street urchins are caught by a burly representative of the law while engaged in the pastime of shooting craps, the law against gambling acts. Law makers have recognized that gambling is an unnecessary evil and have, so far as possible, put a stop to it.

Yet an owner and a contractor can gamble with a million times the stake of the street urchins without fear of the law and it is done constantly under the guise of the lump-sum contract.

For under its terms the contractor agrees that for a certain sum of money he will guarantee the owner against all the unknown conditions involved in putting up a structure. Whether he makes his figured profit or whether he loses so heavily as to be put out of business rests partly on his ability to figure costs but largely on his luck in failing to meet those conditions which would increase costs.

Both parties to this contract stand to gain or lose. If the job costs 20% more than estimated the owner gains to the other's loss. If conditions make considerable saving possible, then the contractor gains to the owner's loss.

Many contractors who in times past have built extensively in your field are no longer operating. Others have taken their place. Perhaps the majority of the missing firms are those who were expected not only to build according to specifications and within the time limit but to gamble that their costs would fall within a fixed contract price. Gambling against variables such as the forces of nature and the conditions of labor—they lost. In many cases their failure involved an added investment on the part of the owner or possibly the surety company. It is certain that no one gained thru the failure.

The contractor is an expert retained to assemble certain materials into a finished structure. The question being asked today is "should the contractor insure the owner that his

structure will not exceed a definite contract price?" In competitive bidding the cost of this insurance is paid generally by the low bidder out of profits or, as frequently happens, out of his capital, for the reason that he is more likely to get the contract as he scales down his allowance for contingencies. In fact the man whose bid includes a safe allowance for insurance against higher costs cannot expect to obtain work under the competitive bidding system. The inevitable result is the bankruptcy of many contractors and an additional cost to the owner or the surety company to complete the unfinished contract. This situation has come to such a point that surety companies are refusing to write surety bonds on fixed price contracts except under specially favorable conditions and frequently recommend to owners the cost-plus-a-fixed-fee contract.

But from the owner's standpoint is it not preferable to know in advance what a certain project will cost? It is true that a careful estimate is due him. It should be made by a reliable contractor and checked by owner's architect and engineer. Such a figure should be more satisfactory than a competitive bid which does not necessarily show the cost of the building but only what some contractor is willing to gamble is the cost of the job.

An issue of bonds for an office building or other structure can as well be based upon a careful preliminary estimate in either case. It can only run below the estimate under the cost-plus-fixed-fee plan. Is not the owner entitled to the possible saving?

Additional financing may be an unfortunate necessity but is there reason why the contractor should be asked to underwrite the accident of greater cost?

We have been operating under this plan almost exclusively for several years. We know that it is possible to convince most business men of the perfect fairness of the cost-plus contract and among our clients are several who would be the last to tie themselves up with us on any basis of contract likely to be unfair or dangerous. We have built on this basis for Montgomery Ward & Co., four successive times; for the Robert Simpson Co., Ltd., Toronto, five separate buildings and for the William Davies Company, Ltd., Toronto, six buildings. For these firms we have been able to start actual construction much earlier than otherwise would have been possible, which means early occupancy. The reason for this is that we can start the foundations just as quickly as the foundation plans are complete and further design and construction may go on co-incidently.

Money tied up during construction earns nothing until the building is ready for occupancy and the interest often amounts to a considerable sum. When we have opportunity to work with the owner, architect and engineer from the very inception of plans and when we begin foundations as soon as the general contour of the building and equipment are determined upon, we are able materially to cut down the period during which the owner's capital is unproductive. Under the lump-sum contract it is necessary that the plans be complete before bids are taken which may delay occupancy for months and without occupancy a building investment is poor as a dividend producer.

But while speed is of first importance in most building contracts, yet fairness to both parties is an equally good reason for its general adoption and on that basis our company is now operating almost exclusively. We feel that the owner should reap any benefit we are able to bring about. To give us incentive to make such savings we ask a moderate percentage of that saving under the estimated cost. Our standard contract calls for a return to the owner of 90% of such savings all of which would have accrued wholly to the contractor under the lump-sum plan. We believe 10% of the savings to be an adequate incentive for the contractor. We have almost invariably made savings for the owner below the estimated cost on our cost-plus contracts and such savings have not been through the padding of preliminary estimates but through changes or economics in construction made with the consent of owner, architect and engineer, which produced either a structure more adaptable to its purpose or of lower cost with equal value. Such changes could be made only with difficulty under the lump-sum contract as the average owner is averse to changing original specifications because of the generally high cost of "extras" or divergence from the original basis of bidding.

Unquestionably the contractor is called in because he is an expert in building and not to absorb the risk entailed in the lump-sum contract. If it is not the purpose of the owner to buy price insurance along with his building then cost-plus-fixed-fee is a better basis.

The Planning of Residential Suburbs with Special Reference to Engineering Features

By F. L. Olmsted, Landscape Architect, Brookline, Mass.

In the technical field of planning residential subdivisions in a comprehensive way there is involved the co-ordinated work of men of diverse expert training relating especially to the following groups:

(a) The design and construction of engineering utilities with due regard to operators' problems, contractual relations and the business and financial aspects of each utility:
- Water supply;
- Gas and electric services and street lighting;
- Sewerage and storm drainage;
- Street construction and maintenance;
- Passenger transportation, etc.

(b) The design and construction of surface improvements considered primarily from the point of view of general convenience and attractiveness of appearance, and the influence on real estate values, also with due regard to maintenance problems, the bearing of the burden of costs.
- General design of streets, blocks and lots.
- Visible details of surface constructions and of above-ground utilities. Parks, playgrounds and kindred recreation facilities.
- Lot improvements external to buildings.

(c) The design and construction of buildings with all the technical subdivisions of that field of design and construction, again with due regard to cost and value.

(d) The general business of watching values as reflected in price and rentals of real estate variously improved and of operating problems.

No man can cover all parts of that field well and thoroughly. There must be collaboration of somewhat specialized experts, but for the most effective collaborations each one must be enough of a city planner to understand and respect the special points of view and problems of the others and to recognize his own limitations. The one who has the best general grip on all aspects of the complex subject and the best executive head will be the natural and the best leader in the co-operation, irrespective of what his own specialty may be.

Primary Considerations

A city planning agency whose field covers a whole city ought to concern itself, in respect to streets, sewerage, drainage, water supply and transportation, with the location and proper capacity of the trunk lines of these several services in relation to each other and to the permanent interests of the whole community, and with questions of source and destination, especially in water supply and sewage disposal, leaving

the details of local streets, service mains and branches for some one else to worry out, so that there shall be the least possible hampering of individual initiative on the part of neighborhood units, of real estate developers and of special departments of the city administration or private utility companies in developing their individual plans so far as is consistent with providing for the few big things that can only be done by united central action. It is not that the ways in which these other local or special services are supplied do not affect the interests of the entire city. They do. Bad local streets all over the city make the whole city in so far bad. Badly planned local service mains all over the city mean a general fire risk or a needless burden of cost or other drawbacks which affect the city as a whole.

But if, because the city as a whole is affected by the way in which all of these details and a million more are decided, the responsibility for planning all of them is thrown back upon any single centralized planning agency, its human limitations will surely cause it to fail except in so far as it delegates and decentralizes most of the work and manages to make it stay decentralized.

The way in which comprehensive city planning can best make progress is by not biting off more than it can chew, especially by concentrating on the things about which the advantages of centralized and interrelated control of planning are indisputably greater than the disadvantages.

These things differ enormously in respect to the size and character of the territorial unit under consideration. In the case of a residential neighborhood small enough to be fairly homogeneous, a planning agency comprehensive in its scope as to that particular neighborhood and not burdened with similar responsibility for each of the other neighborhoods in the city or for the larger problems which are insoluble except by joint action on behalf of many neighborhoods, can properly and effectively carry its centralized planning much further into detail than is at all wise or practicable for a planning agency whose field is the whole city. The residential neighborhoods planned under the direction of the United States Housing Corporation have generally been of this small homogeneous sort, like many other industrial housing developments and innumerable less completely planned residential subdivisions of land companies and realtors.

The purveyor of water, gas or electricity, the specialist in one of those utilities, can make probably a better job, and certainly a quicker and more efficient job, of planning the supply and distribution of his own utility, considered in itself, if he is given a free hand, than can be done by any humanly possible comprehensive and centralized city planning agency, with which that particular utility is but a fraction of its responsibilities. The same is true of the specialized professional or commercial purveyors of houses, of parks, of almost any urban commodity; and it is emphatically true that individual citizens and owners of real estate are on the average and in the long run safer judges of the interests of their own localities than any central authority can be. The justification for comprehensive city planning is simply that there are some aspects of almost all specialized or localized planning where control of the specialist or localist planner, by application of the comprehensive city planning point of view, is apt to save so much more through avoidance of physical interference and duplication of waste of effort in actual construction and maintenance, than it loses through extra administrative machinery and loss of time and duplication and waste of effort in planning, as to be well worth its cost.

Recognizing, then, that the first problem of city planning, in the limited practical sense, is to mind its own business, to concentrate on the problems where its value is most certain, to avoid those where its advantages are apt to be purchased at too high a cost, in circumlocution and wasted effort, let us consider the more important city planning functions in connection with a residential neighborhood unit, first of the city planning agency of the municipal corporation whose field is the entire city, and second of a proper local planning agency exclusively for the neighborhood. The latter most often represents the land owner, such as a development company, the United States Housing Corporation offering a good example, but sometimes represents a syndicate or co-operative group of land owners, and might represent a subordinate municipal unit with certain powers delegated by the state.

Thoroughfares

First as to thoroughfares: So far as I can recall, in all the operations of the United States Housing Corporation it was only in Philadelphia that the municipal authorities had a plan of streets not yet dedicated or otherwise acquired, in which there was a clear and conspicuous distinction between those which the city regarded as necessary for traffic between points lying outside of our development and those which were strictly local. The Corporation was required to adhere to the former on pain of receiving no co-operation from the city in respect to sewerage and water supply, but was permitted to rearrange the latter very much to suit itself. Without here stopping to discuss the advantages and disadvantages of the particular plan of through streets on which the Philadelphia authorities insisted, or of the intermediate local street plan which the Corporation substituted for the conventional Philadelphia plan, I want to emphasize the soundness of the principle which they followed and the deplorable absence of that principle in most cities. Generally the Corporation found no streets planned except those actually dedicated to public use, and among streets dedicated or even open and more or less completely improved, no clear recognition of which were needed as thoroughfares for more than local use. Through the power of requisition intrusted to the Secretary of Labor the Corporation was enabled where necessary to acquire the fee of dedicated streets, to close them and to lay out new street plans, and it availed itself of this power in a good many cases. In doing so it took special pains to provide what it believed to be suitable through lines of traffic important for the city as a whole, but in so doing it was performing a function which no city ought to leave so completely in the hands of local proprietary interests, as most cities do. On the other hand, in many cases the platted streets which had been dedicated long in advance of actual improvement and installation of utilities, mainly or entirely as a device to facilitate speculative transactions in lots, were found to be laid out so totally without regard to any distinction between thoroughfares and supplementary local streets, that the Corporation was fain to accept an uninteresting, unattractive and often a somewhat extravagant plan of local subdivision because any street changes within the limited area which it controlled would interrupt lines that might become important as thoroughfares.

Sewerage

Again, as to sewerage and storm drainage, the usual experience of the Housing Corporation was that in undeveloped or partially developed areas the cities had no plans for the new trunk lines required to serve the lands of the corporation in common with other lands, although generally willing to co-operate in the construction of them when plans were prepared by the Corporation, which the city ought to have had ready in advance, at least in tentative form, for its own protection. A somewhat extreme case was in Portsmouth, Va., where a tract near the edge of the city's growth previously platted, partially sold off in lots, and in part provided with sidewalks and water, was acquired by the Housing Corporation. This tract could be sewered only by constructing a wholly new outfall to tidewater at the expense of this one small development, the intermediate territory having sewers of capacity sufficient only for the population now being served, the city having no plans whatever for taking care of sewerage from its outlying portions, and no machinery being in existence for securing relief by joint action within any reasonable time. The cost would

have been far too great and the only feasible solution was the use of leading cesspools under very unfavorable conditions as to soil and ground water.

On the other hand, there were some instances where a city was up on its toes and had its sewer system planned well ahead of the actual physical extension of urban development, and where there were extreme and arbitrary requirements as to the design and capacity of the lateral branches of sewers, and especially of storm drains in strictly local streets, which placed upon the housing project a needless burden of initial development cost which could only be met by curtailing something else which would be worth more to the occupants than the more permanently ample and satisfactory sewerage and storm drainage.

Case after case arose where the city authorities did not plan ahead as to the things which concern areas so large that only the city authorities can reasonably be expected to plan them. There were occasional cases of city authorities tying the hands of local initiative by elaborate and arbitrary regulation of details which are primarily of local and not of individual concern.

I know much of this is an old story, but my experience in supervising the planning of government housing projects in nearly a hundred places scattered over the country has deeply impressed upon me the necessity in our cities for hammering away on a few plain, well-established elementary principles and on their simplest and most obvious applications, until that much at least is as firmly established in the practice of American municipalities as the habit of having a fire department and a police department.

Routine City Planning

I am strongly impressed with the feeling that we could accomplish much more valuable results in the line of propaganda by concentrating first on such undebatable rudiments as the systematic advance planning of thoroughfares and main drainage systems, both storm and sanitary, with the selection of school and playground and park sites, and with districting, in the near background, and by hammering away on the economic need for every city to maintain in its service an engineering staff suitable in size and organization to keep well ahead of the game in at least these elementary rudiments of comprehensive planning. May I here parenthetically suggest that "suitable in organization" means, among other things, that part of the organization, if that part be only one man, shall be assigned exclusively to planning future undertakings, not yet authorized or decided on, and may under no circumstances be devoted to current or routine work, even if the appropriation for routine work is exhausted. Otherwise, planning for the more distant future goes to the wall.

I am not saying that the available sort of assistant in the average city engineer's office is likely to do a very inspired quality of all-round city planning, but he can make a very useful beginning of city planning where it is perhaps most urgently needed and where it can get a chance to win its way by results. Such work can be the means of educating those directly engaged in it, and gradually the other city officials, with whom they come in contact, in a broader and larger conception of city planning. If consultants of wider experience are plainly needed they will be called in from time to time, and when they are called in they will work with and through a permanent organization that has the basic city planning viewpoint instead of making a report in vacuo and listening in vain for an echo.

Co-operation with Real Estate Men

But to return to the subject of residential subdivisions and the city's special functions in regard to their planning. School sites, playgrounds and local parks and the subject of districting occupy a curious position on both sides of the border between the planning functions of the city at large and those of the local planning interest. Where a residential neighborhood is constructively planned by a land company or other local agency on a sufficient scale, it is clearly a matter of enlightened self-interest to plan for a suitable school and playground site, for a school is a necessity of a successful residential neighborhood, and the territory tributary to a single school is the normal neighborhood unit under ideal conditions. Even where the unit of subdivision is considerably less than a school unit, the importance of having a school and playground well located in respect to the subdivision is a matter of keen interest to a clear-thinking planner of a subdivision, and will lead him to take the initiative in negotiations with the school authorities looking towards its establishment. It has been fully established that a well located school and playground or even a site for the same definitely fixed and known to be embraced in the program of the school authorities, adds to the value of all the remaining land in the territory to be served by the school more than the value of the land withdrawn for the purpose, just as a local park of suitable size, location and character and of which the proper public maintenance is reasonably assured adds more to the value of the remaining land in the residential area which it serves, than the value of the land withdrawn to create it. Enlightened realtors who are engaged in the legitimate business of producing and selling what the ultimate consumer wants, for the best price that a satisfactory article will bring, know these things and act accordingly when circumstances are favorable. The speculative subdivider who seeks his profit in selling to suckers, themselves largely speculators on a small scale, like Wall Street lambs, or who relies for his profit more on abstract skill in salesmanship than on the inherent value of what he offers, generally does not.

But even the thoroughly legitimate and thoroughly enlightened realtor whose subdivision is considerably less than will support a school and playground, or a local park, cannot afford to contribute land for the whole thing largely for the benefit of other subdivisions. He can perhaps afford to do somewhat more than his share but not much more.

He is always tempted to take a chance on the optimism of the buyer of lots, who expects that the necessities of a residential neighborhood will be supplied somehow by somebody, and let the school authorities come along and do the best they can by purchase, when the time comes that they must meet the demand for a school.

Such a subdivider will meet the school authorities at least half way in providing school and playground lands well located and suitable in size, shape and character if they will go their half of the way at the time the subdivision is planned instead of standing off until the favorable opportunity is gone. I may say incidentally, that this was precisely the usual attitude of the United States Housing Corporation in its subdivisions.

We sought out the public school authorities and earnestly tried to arrive at an agreement with them as to the best school sites, except those cases where existing schools would serve, and having agreed on the sites we avoided any development which would prejudice their use for school purposes and tried to reach an equitable agreement with the school authorities for taking them and developing them, stretching a point if necessary to get the best practical results.

For these reasons and because the initiative in such matters cannot be expected to come from the smaller subdividers or from all the larger ones, and still more because the economical relation of one school site to another turns on matters which interlock over districts much larger than any single residential neighborhood, it is a matter of serious consequence that the school authorities and the park authorities of a city in co-operation with the other central planning agencies should also plan well ahead in the matter of distributing schools and playgrounds and local park sites at least in a tentative and flexible way, and instead of waiting for enlightened subdividers to hunt them up and offer them a chance, should be on the

spot as soon as a subdivider shows the preliminary symptoms of an outbreak, and work out a mutually satisfactory solution, using the assessment principle if necessary for distributing any part of the burden of site cost which cannot be equitably covered between the subdivider and their general funds.

Planning of Local Streets and Lots

And now we come to the planning of purely local streets and the lots which front on them. I have said again and again, and certainly everything I have seen in the operations of the United States Housing Corporation confirms it, that much is to be gained and little lost by the city's leaving the greatest latitude of choice to the individual subdivider in the matter of local streets and lotting, by postponing the detailed planning of such streets until the use of the land for dwellings is so close at hand that the desires of the actual user can be estimated with some precision and by acting as a guide and helper to the subdivider who is in the business of producing commercially something that he expects his customers to buy because it suits them, instead of dictating to him in a high-handed way because they have some fixed theory of what a proper subdivision ought to be like. Mind you I always except an occasional local street which ought to be fixed in a particular place or at a particular grade in order to provide an economical location for a sewer or storm drain or other public utility trunk line which does not influence the individual subdivider, and I expect some compulsion in regard to keeping unbroken a site specially desirable for a school or playground or other feature of importance to the neighborhood or the city, provided the city planning authorities are fore-handed enough to know the real needs. Moreover, there are certain things to be avoided unless there are the strongest special and local reasons for them such as dead end streets, unbroken blocks very much more than six hundred feet in length, needlessly excessive grades and arrangements likely to result in houses having inadequate light, air or means of access. But when all such exceptions are made the principle stands, of giving the individual subdivider the maximum liberty of discretion and acting as live advisor and helper rather than as on obstructionist or a keeper who would put him in a straight jacket. This applies completely to strictly local streets not at all required for any purpose except access to lots which front on them and it applies with qualifications to secondary connecting streets which may be feeders of important thoroughfares.

There is no one way to lay out lots and blocks, there are no half dozen ways, so much better than others that a city planner can afford to canonize them, or say with certainty that no other arrangement is in the same class. Liberty of choice and individual initiative and ingenuity with the penalty of losing money if a relatively unsaleable result is produced will in the long run give better average results and certainly a more varied and interesting city than plans imposed in detail from above.

For the individual subdivider of residential neighborhoods, himself and for the planning agency of the city as his guide and helper, experience suggests a number of points, as suggestions but not as rules. Few of these can here be cited. Besides the few "don'ts" already cited, I would say of local streets on the esthetic side, out of my experience with the housing corporation work, that such streets to secure a quality of domestic charm, ought not to run in a straight unbroken vista for more than a few hundred feet at a stretch where it can be avoided without material loss, that where the street vistas are thus made reasonably short by curves or obtuse angles in the street it is usually desirable that the houses seen in connection with each other on both sides of the bend should seem to be in continuation of each other and to relate to the continuous line of the street as it makes the bend rather than that there should be a discontinuity in the houses where the street bends by facing some of them on a cross street or greatly verging the set back, that the relation between changes in the gradient of a street and the points where curves or angles occur and also the relation between the grades of the street and any grouping of houses is of far greater importance to the appearance of the result than is generally realized, that slight variations in the set back of the building line of a street are valuable as adding to its appearance but that there is the greatest danger of overdoing the variation. On the practical side, if you will not misunderstand me as implying any conflict between the esthetic and the practical, I might mention, besides the controlling motive of spacing the streets so as to give marketable lot depths and so avoid wastefully acute or tapering corners as far as practicable, the importance of fixing the locations and grades of the streets not only to minimize the cut and fill on the streets and avoid lots needlessly depressed below the streets or even excessively elevated above them, but also to minimize the total cut and fill on both streets and lots when the latter are developed, so as to give satisfactory and economical sewer profiles, and (especially on flat grades and where combined sewers or storm sewers in front of every lot are not inevitable) so as to carry the storm water in such a way and to such points that the amount of storm sewer construction can be reduced to a minimum without anywhere overloading the gutters. To keep these desiderata all in mind at once, and skillfully to strike a balance of these practical advantages and disadvantages dependent on location and grade while shaping the whole to a result pleasing to the eye is no joke, but the success with which it is done easily makes a difference of thousands of dollars per mile of street both in cost and in resulting values.

Acknowledgment

The foregoing is from a paper read by Mr. Olmsted at the latest National Conference on City Planning.

Some Common Errors in Municipal Financing

By A. R. Hebenstreit, City Manager, Albuquerque, New Mexico

Errors in municipal financing usually occur in one or more of the four following particulars: Crude financial legislation; lack of modern accounting methods, including a real budget system; improper handling of bond issues and certificates of indebtedness; and failure properly to regulate public utilities and public utility franchises.

Crude Financial Legislation

This is often brought about by an effort on the part of a well meaning legislature to arrest or curb the actions of public officials who have previously, unknowingly or wilfully abused good business practice. Oftentimes financial legislation is affected by the influence of large corporations, who oppose certain classes of legislation for selfish reasons and launch other legislation of less merit for the same reasons. Oftentimes legislators will legislate to affect a particular locality which has come to its attention, neglecting to ascertain the full import of that legislation to other localities. I believe it is the duty of municipalities to keep their legislature informed of local conditions so as to have their legislators represent them intelligently. This can be accomplished best by an organization of a state league of municipalities in each state in the Union and these states in turn organize a national league of municipalities for the purpose of representing municipalities in national legislation.

Lack of Modern Accounting Methods

Lack of proper accounting methods in a municipality or in any business is the cause of bankruptcy or wastefulness in a large percentage of cases. Detailed knowledge of every financial transaction, no matter how trivial, will oftentimes avoid unnecessary expenditures and with the proper utilization of the budget system will cause the city officials to anticipate the needs of the city and make necessary provisions for same.

The budget system must be utilized properly, otherwise it is more of a hindrance than an advantage. For instance, in the state of New Mexico, the law requires that the expenditures for the ensuing year shall be budgeted for approval. However, when it comes to budgeting the income of a municipality, the budget system is entirely discarded by an arbitrary rule which says that no municipality will levy beyond a certain limit. In other words, we have a budget for expenditures but no budget for revenue. The budget system in the state of New Mexico is, therefore, useless. It is hoped through the efforts of the New Mexico League of Municipalities to submit to the next legislature a workable budget system for municipalities.

Improper Handling of Bond Issues

Bond issues are opposed by the conservative element, although recommended by the more progressive element. It is a well known fact that bond issues are legitimate and equitable when made to pay the cost of a permanent improvement; and when the sinking funds necessary to retire the bond issue are distributed over a period of time so that all of the future generations deriving benefits from the permanent improvement will assist equally in paying for that improvement. The usual method adopted by municipalities, and which in my opinion is one of the greatest mistakes that can be made, is neglecting to establish sinking funds for the retirement of the bonds immediately after the public improvement is available for use to the people; also failure to extend the payments over a period of time approximately three-fourths of the recognized life of the permanent improvement. Common practice is to postpone the first sinking fund requirements for a period of 10 to 15 years so as to relieve the present generation even though that generation will have the use of the permanent improvement. Mistakes are also made in extending the period of the bond issue, far beyond the life of the improvement. To illustrate this last point, I have knowledge of one bond issue which provided for payments over a period of 20 to 30 years, although the life of the structure, when originally built was not more than 15 years and should not have been bonded for a period of more than 10 years. Another mistake often made in state laws relative to bond issues, is that they require a bond election to be held at a general election. This is absolutely wrong, for the reason that other political issues oftentimes cloud the real issues relative to the bond election and many times a meritorious bond issue is defeated because of the ability of one political faction to defeat another.

Certificates of indebtedness are only of value where it is impossible to have a bond issue at times other than at the general election or where the improvement contemplated is a district matter rather than that of the entire city. The issuance of certificates of indebtedness for a community improvement in my opinion is poor practice unless made necessary by the inability of the governing body to call a bond issue election. The governing body must have the power to issue certificates of indebtedness in the operation of public utilities because if a major improvement is contemplated there are very few businesses capable of financing such an improvement out of one year's earnings. It is then necessary that such improvements be spread over a period of years by issuance of certificates or until such time as a bond issue can be floated.

Failure Properly to Regulate Franchises

Public utilities and public utility franchises should be at all times under full supervision of the governing body of the municipality in order that their operation and construction may be regulated and the granting of franchises should be made a matter of income to the city in return for the benefits derived by the public utility from the city. By this I do not mean that public utilities should be militated against by any governing body of any municipality but that the governing body should have the power to regulate that public utility so as to guarantee a fair earning power and to protect the citizens against excessive rates.

The foregoing paragraphs are from an article contributed to a recent issue of Pacific Municipalities by Mr. Hebenstreit.

Stone and Gravel Road Construction in Ontario

By J. G. Wilson, County Road Superintendent, Halton, Ont.

The county road, which is intended to link up the different centers in the county and to be a feeder to the Provincial County Road, doubtless will have to be constructed of stone or gravel, and it is very important that they should be built in the best possible manner, said Mr. Wilson in addressing the annual meeting of the Ontario Good Roads Association.

Method of Construction

1. The roadway should be staked out straight in the center of the road allowance from 24 to 28 ft. wide, depending on the locality and the amount of traffic it will have to take care of.

2. The hills should be cut down to a grade of not more than 6 per cent., if possible, for after the road is constructed it is not likely to be done again, and if it is, it will be at a considerable extra cost, and a little extra cost at the time the road is built will give satisfaction for the cost is soon forgotten, but a bad job is an eye-sore and an inconvenience for all time to come.

3. It should be underdrained where necessary and culverts placed at the natural water courses to carry the water across the road; never carry it along the road to save putting in a culvert.

4. The road should then be well graded and the crown for a single track road should be 1 in. to the foot to allow for settling, with good open ditches with sufficient outlets. Water should never be allowed to stand in the ditches as it will soak under and injure the road.

The preparation of the road as stated above should be done one year before the metal is put on to give it time to consolidate; if not, it should be thoroughly rolled. The harder you get the foundation the bettter, for it is much easier to consolidate the stone on a firm foundation. One never gets good results when building on a soft or yielding sub-grade. Very wet weather is a bad time to build a road, as it is important that the foundation of a road should always be dry; it is also important to be dry and hard when it is being constructed, for when the road is wet the stone is pressed down into the mud and the mud is forced up through the stone and in a very short time the road becomes rutted and soon goes to pieces.

Stone Roads

After the road has been thoroughly prepared the next thing to consider is the quality of the stone, which should be hard and tough. Of course conditions and the convenience of the stone to the work will have to be considered in deciding what to use, but don't use a poor quality for the sake of saving a few cents a yard.

The next question is width and depth of metal for a single track road. Ten feet should be a suitable width but it should not be less than that; wider would be preferable. The depth of the metal should be determined by the amount of traffic it will have to take care of and the kind of soil on which it is built; for instance, where the foundation is of a gravelly nature, making a good natural drainage, a depth of 8 ins., when consolidated might be sufficient, but where you have to build on a sub-grade of heavy clay, it might be necessary to make it 12 ins. In that case the road should be excavated to a depth of 6 ins. and filled with coarse stones and thoroughly rolled when dry. For the second course stone from 1½ to 2 ins. would be a suitable size and this course must also be thoroughly rolled, beginning at the edge of the stone and working

to the center. The screenings are then put on and plenty of water to make a slush, the roller should still be kept going and at the same time the road should be well brushed with stable brooms to fill this void.

The water wagon should have wide tires, not less than 4 ins., to prevent rutting the road; in fact, all wagons used on the job should have wide tires.

It is very important that the foreman in charge of the work and the man who operates the roller should be competent men, and work together with the end in view that when the road is completed it will be the best road in the county.

Gravel Roads

Gravel roads, while not as durable as broken stone, have some advantages on account of being easier to construct, easier to maintain and cheaper. Of course, the length of haul is a big factor in the cost of any kind of road, and where the length of haul brings the cost up to anywhere near the cost of stone, gravel should never be considered.

Gravel varies greatly in quality but is, as a rule, suitable for roads where the traffic is not too heavy.

When you can get the right proportion of stone from pebbles up to 2 ins. with just enough sand to fill the voids, you have an excellent material with which to build a road, if the road is well drained and you put on a sufficient depth of gravel, say from 10 to 12 ins., and have the road well crowned it will stand up under quite heavy traffic, but it is very rare one will get a pit where the whole body of gravel is as I have described, but in most pits there is some good gravel, and great care should be taken to see that only gravel of good quality is used.

Dirty gravel should be avoided. While gravel with an excess amount of clay will pack quickly and make a good road in dry weather, when the rains come in the spring or fall it turns to mud and ruts badly and soon wears out.

A few stones are not objectionable if the gravel is otherwise good as these can be raked forward and placed under the next load. Never leave them in a heap at the end of the load. They prevent the gravel from settling evenly.

See that an even grade of gravel is taken from the pit. One part of the pit may be very fine, another quite coarse and still another may contain too much clay, and the teamsters all crowd in at the same time and load wherever it is most convenient with the result that every load is of a different grade and where the roads are consolidated it will be very uneven and one will be able to tell where every load was dumped from the depressions that will be found. A road of this kind is very objectionable.

Where the gravel has a large amount of stones or boulders it should be run through the crusher. Gravel should be spread on the road at least 7 ft. wide and from 10 to 12 ins. in depth. While the traffic will in time consolidate the gravel and in a year's time there may not be much difference between it and a road that is rolled, the satisfaction of having the road in a finished state from the beginning is well worth the cost of rolling.

Registration of Professional Engineers in Oregon

The Oregon State Board of Engineering Examiners is now fully organized and prepared to receive applications for registration of the professional engineers in Oregon, and others who expect to practice engineering in Oregon.

The Board has held several meetings to date and has worked out and adopted complete by-laws, rules and regulations for the government of the action of the members of the Board and methods for holding examinations.

The following officers have been elected to serve for the next biennium ending July 1, 1921: O. Laurgaard, City Engineer of Portland, President; F. D. Weber, Electrical Engineer for the Oregon Insurance and Rating Bureau, Vice President; A. B. Carter, Civil and Mining Engineer, Secretary.

Headquarters for the Board have been established at 520 Corbett Building, Portland, Ore., where the necessary application blanks for registration without examination, and copies of the law and all other information may be received at request.

The business of the board will be transacted to a large extent by committees which have been appointed.

Under the provisions of this law, it will be necessary for all civil, mechanical, electrical, mining, chemical and all branches of professional engineering, to register.

Applications may now also be made for examination by those engineers who have not the required six years of actual practical experience.

It is very important that all engineers who expect to register without examination file their application blanks as soon as possible in order that the board may have sufficient time to pass intelligently on their qualifications.

The professional engineers who expect to practice after January 1, 1920, according to the law must be registered, so it is very important that the applications of not only those who expect to be registered without examination, but also those who expect to take the examination should be in before January 1, 1920.

The Street Lighting Problem of the City of St. Louis

By Ralf T. Toensfeldt, Electrical Engineer, Department of Public Utilities, City Hall, St. Louis, Mo.

The contracts for street lighting between the City of St, Louis and the Union Electric Light & Power Co. and the Welsbach Street Lighting Co. of America expire next year. The situation involves many serious problems and resolves itself into a question of high finance as well as engineering.

If the present procedure is continued, the city will be involved in large increases in cost, fully justifiable in view of present economic conditions. The situation is further complicated by the condition of the city treasury, which faces a greater deficit than usual on account of the passage of the prohibition laws. It, therefore, behooved us at the City Hall to analyze costs and find some more economical way to accomplish the end desired.

Present Contracts

There are two contracts in existence at present, one for electric lighting in the downtown or arc district, and the other for gas or naphtha by which the rest of the city is lighted.

The Union Electric Light & Power Company is contractor for the arc district, furnishing and maintaining all equipment and supplying current, for the sum of $12.25 per arc lamp per 1,000 lamp hours, or $49.66 for the average year. They also furnish incandescent alley lights for $4.49 per 1,000 lamp hours or $12.20 per average lamp year. There are 2,291 arc and 767 incandescent lamps, so the total yearly cost for electric lighting amounts to $124,138 for an average year.

Similarly, the Welsbach Street Lighting Company of America is the contractor for the gas and naphtha district, furnishing all equipment and maintenance, supplying gas, and lighting and extinguishing the lamps, for $5.62 per 1,000 lamp hours, or $22.78 per lamp year. There are 26,019 such lamps in service, making a total cost of $592,829 per year for gas and naphtha lighting.

The city's total annual bill for all street and park lighting is $734,967.

An investigation of the conditions in other cities reveals the fact that the probable cost of arc lamps under a contract let at the present time under the same conditions as the old contract, would be between $90 and $100 per lamp per year, doubling our present cost for the arc lamp district.

Current cost for the installation is a minor consideration amounting to about $20 per year. The remainder consists of labor, electrode and glassware renewals, repairs, and amortization of a very expensive installation in a comparatively short time.

The Type "C" Series Tungsten 1,000 Watt Lamp

It is obvious that if a type of light can be found which will give just as effective lighting with a reduction of the total of these items, it will be possible to reduce the cost of lighting to the city. The type "C" series tungsten 1,000-watt lamp is at present the magnetite arc lamp's only competitor as to lighting efficiency. It gives slightly less candle power per watt than the arc, and a different quality of light, being more yellow in color; however, it has a distinct advantage in that it is an absolutely steady light, while the arc flickers more or less. Furthermore, less cleaning is required with the tungsten than with the arc, since there is no actual combustion taking place and, hence, no deposits of ash on the enclosing glassware.

As to the cost, the type "C" lamp requires a somewhat less expensive installation than does the arc. The cost of type "C" fixture and lamp is approximately one-half that of an arc, and series transformers are less costly than rectifiers. Excepting for this, the installation cost is approximately the same.

In regard to maintenance, type "C" lamps are slightly cheaper; they do not require so frequent cleaning, and renewals are necessary only once to every seventeen times for arc electrodes. Substation attendants are entirely eliminated because transformers require no attention, while rectifiers, necessary for an arc system, require at least one operator per substation.

A change to type "C" tungsten, therefore, would effect some saving in operating cost, but the feature of amortizing an expensive installation in a short time still remains. To overcome this feature, it would be necessary to let a very long-term contract, which would be very disadvantageous, or eliminate this feature from the contract entirely, by municipal ownership of the entire equipment. This would mean an effective saving, since the rate of interest paid by the city is considerably lower than that paid by private corporations, and, above all, because the city can amortize the investment over its actual life instead of over a short period of years.

Municipal Ownership Suggested

In computing the cost of such an installation, the cost of a conduit system has been disregarded, since the city now owns one duct in each conduit in the city streets and alleys, and all such ducts located in high tension conduits which would be used for this purpose are vacant. Unfortunately, Ordinance No. 18,680 (the "Keyes Ordinance"), which provides for these ducts for the city, specifies their use as for fire and police telephone and telegraph cables. Inasmuch as it would be exceedingly bad and dangerous practice to install such cables in high tension conduits, these ducts would be useless for all time under the terms of this ordinance. It is believed that an agreement could be made by which these restrictions would be waived, giving the city the right to install in these ducts, cables for street lighting purposes.

An estimate of the cost of such an installation shows that it could be made for approximately $400,000. If it became necessary to install conduits, $1,500,000 additional would be necessary.

Annual Cost of Lighting "Arc" District

Assuming that duct rights can be obtained, the annual cost of lighting the arc district would be as follows:

With current at 2c	$164,190
With current at 1½c	140,160
With current at 1c	116,130
With current at 0.887c (water power rate)	110,667

as against a present cost of $124,138, and a probable future cost of $206,190 or more.

If it becomes necessary to construct separate conduits for this purpose, the annual cost would be as follows:

With current at 2c	$271,640
With current at 1½c	246,430
With current at 1c	222,400
With current at 0.887c (water power rate)	216,930

It follows from these figures that a very marked saving can be effected, provided the city's duct space, now unused, can be employed for this purpose. If, however, new conduits must be built, no saving would result, but the annual cost would be approximately the same as the probable new bid price under the existing plan.

The present contractor has been approached on the matter of duct space, as well as the sale of such parts of the present equipment as would be useful to the city under the new plan and seems favorably inclined to the proposition. Should the purchase of the old cables, poles and laterals, in place, be negotiated, the cost to the city would be even less than that estimated, since this contemplated an entirely new installation.

It would be entirely unnecessary to remove these cables from their present location, since the city ducts, now vacant, could be exchanged for ducts used for this purpose.

This scheme has a further advantage in that it offers free competition without again reopening a dispute over the "Keyes Ordinance," the intent of which was to eliminate the opening of downtown streets for the purpose of installing underground equipment. A letting under the old plan would necessitate either a permit to the successful bidder to again tear up all streets in the underground territory to lay the needed conduits, or a restriction of competitors to those who now have the necessary facilities installed. Such a restriction would practically eliminate all competition, since only the present contractor is equipped to handle this system without circumventing the "Keyes Ordinance."

Alley lighting, now being done by incandescent lamps, can be practically eliminated by the proper placing of street lights. done, but with a city-owned system, it would be an easy matter to take care of such locations from the street circuits. There may be a few isolated cases where this could not be

Gas and Naphtha Sections

The gas and naptha lighting contract, because of the entire distinct character of the two problems, is divided into gas and naphtha sections. The gas light problem may be solved in several ways. A renewal of the present contract under which the contractor would furnish everything, could be made at probably only a small increase in the price per lamp. Here, again, the elements of cost are renewal of mantles and glassware, labor of maintenance, and amortization of the equipment; renewals, gas, and labor of maintenance, are fixed, but amortization of the equipment varies inversely as the length of the contract. In this case especially, a long-term contract is inadvisable, because of the advancement of the art of lighting along different lines and the necessity that the city adopt the best as it is developed. Then the problem once more becomes one of amortization. The gas mains, of course, cannot be taken over by the city, and, since the charge occasioned by them is properly taken up in the gas rate, they have not been considered in these computations.

There remain the service connection, the post, the top and the burner equipment. It would not be desirable to purchase the tops and burners equipment since these would not be useful should the city ever desire to convert the system to some other type. The estimates are, therefore, based on the purchase of the posts and services, buying gas from one contractor, and service, including the furnishing of tops and burners, from another.

No accurate cost of posts and services is available, but the present owner has given us a rough figure, which is believed to be high. However, computing the average annual cost on a basis of this figure, charging gas at 50 cts. per 1,000 cu. ft., and estimating the cost of service at a somewhat higher

value than it now costs, the resulting cost is $480,702 per year as against $526,950 per year now paid for an equal number of gas lamps. The annual saving is, therefore, approximately $46,000 per year by municipal ownership of posts. The investment necessary, which has been charged off in the annual cost, will be approximately $560,000.

The gasoline lamp situation offers an entirely different aspect. Gasoline has more than trebled in price since 1900; as a result, the gasoline lamps now under contract have been operated at a loss to the contractor. Prices in other cities for similar service are more than double the present cost to us, and in view of the computation on gas lamps, it seemed hopeless to reduce this cost sufficiently with any combination of municipal ownership. Consequently, a system of electric lighting has been laid out covering all the parks and those gasoline lamps installed on the streets, which could neither be abolished nor converted to gas at a reasonable cost. The entire installation cost would be approximately $190,000 for the parks and $110,000.00 for other gasoline lamps, there being 1,818 park lamps and 1,079 street gasoline lamps.

The annual cost of such an electric installation, including interest, depreciation and maintenance, would be as follows:

With current at 2c	$ 58,670
With current at 1½c	54,700
With current at 1c	50,750
With current at 0.887c (water power rate)	48,250
as against a present cost of	65,922
and a probable cost of	132,000

In this case the city would own the entire equipment, simply purchasing power.

In view of the figures on gasoline or naphtha lamps as compared with electric, it would seem that the entire gas district might be electrified to good advantage. However, park lighting and street lighting differ greatly in construction details. In parks, steel armored cable can be used to advantage and conduit work is confined to a minimum, becoming necessary only where road crossings cannot be avoided. On streets, intersections, sidewalks, driveways, and alley crossings, all necessitate the laying of conduits, greatly increasing the cost of the installation.

A rough estimate of the cost of electrification made it clear that an expenditure in the neighborhood of $5,000,000 would be necessary; it was promptly dropped as a financial impossibility.

For such an installation as that contemplated, the approximate funds necessary would be as follows:

Electric (arc) district	$400,000
Gas	560,400
Gasoline	300,000
Total	$1,260,400

The probable annual cost of these installations, based on 2c electricity and on 50c gas, is as follows:

Electric (arc) district	$164,190
Gas	480,702
Parks (gasoline)	54,700
Total	$ 699,592
as against a present cost of	734,986
and a probable cost, under new similar contract, of	893,380

This plan then effects a saving of $35,376 over the present costs and $193,788 over the probable cost, besides entirely avoiding any possibility of trouble over the "Keyes Ordinance" and giving full competition. It would further permit the city to extend the electric district into gas territory or vice versa, if it so desired, to a limited degree without excessive expense or litigation of any kind due to restricted areas.

The figures given above are based upon liberal estimates and should be considerably lowered when actual bids are taken, cheapening the cost of installation as well as the annual cost, and effecting an even greater saving than that estimated.

These are the schemes we have worked out to hold down the cost of street lighting as much as possible, at the same time making the system more flexible. We would be able to adopt any new type of light we chose without an endless amount of discussion and disputation with contractors.

The problem now is to persuade the powers that be to make a very profitable investment for the city and talk the owning companies into falling in with our ideas. The utility companies are inclined to admit that the schemes have merit, but the question of price is a difficult matter on which to reach an agreement.

It is hoped that a satisfactory solution will be reached before the city is confronted with the imminent necessity for making new contracts.

Acknowledgment

The foregoing paper by Mr. Toensfeldt was presented before the Engineers' Club of St. Louis and published in the Journal of the club for May-June, 1919.

Herbert Hoover: A Modern Engineer

(Having performed a series of labors beside which those of Hercules pale into insignificance, Mr. Hoover has returned to his own country. He has been politely received by the public and the press, but all the salvos of applause were for the military heroes. We are, as yet, unable fully to appreciate Mr. Hoover's services to our nation and the world. It is not improbable that future and wiser generations will hail him as the hero of the world war of 1914-1918. Meanwhile, in returning, he was well received by his own kind, the engineers. The following paragraphs are from a speech by William L. Saunders at the Welcome Home Dinner given Mr. Hoover by the Society of Mining and Metallurgical Engineers on September 16, in New York.—Editor.):

Here at last we have the example of an engineer who typifies the modern definition of engineering, which is thus written in large letters on the wall of the engineer's library in New York: "Engineering, the art of organizing and directing men, and controlling forces and materials of Nature for the benefit of the human race." How well this modest mining engineer has shown that he has the art of "organizing and directing men!" Of the many thousands working for him, here and abroad, it is said that not only have they given him loyal support, not only are they glad to work for him, but every man of them would take off his coat and fight for him. How well he has shown his capacity for "controlling forces and materials of Nature for the benefit of the human race!"

This definition of engineering would have been amazing 40 years ago. The civil engineer was then a surveyor, a mathematician and a bridge designer; the mechanical engineer an educated mechanic, a designer and draughtsman; the electrical engineer was unknown outside of the school and the laboratory, while the mining engineer was a combination of the geologist and that kind of a chemist who could tell how much phosphorus there was in a steel rail. I make this statement with apologies to Alexander Holley, who in his day was the one and only mining engineer known beyond the fence of the workshop or mine.

But the engineer is at last coming into his own. We see the dawn of a new day; truly there is a new order of things. The great centers of the world are now industrial centers. The prosperity and strength of nations in peace and war rest now upon the factory system, the shops, the railways and steamships, the mines, the smelters and the public works. And who is responsible for this? Who plans and executes

these things? It is the engineer, civil, mining, electrical, mechanical, chemical and automotive. Such captains of industry are by education and experience best fitted to steer the ship of state.

The place for the engineer is not in the dark confines of the hold below, but on the upper deck, yes, on the bridge. We are told that practically all the executive heads of the organization for the relief of Belgium were engineers. Who like an engineer is as well trained by education and experience to meet emergencies? He must be prepared for extraordinary conditions. He must foresee these conditions and be ready to act quickly. A mine manager, usually a mining engineer, when told that a pump has broken down in the mine, cannot wait for the common remedies, but must provide in advance for experts and appliances to be on the spot at once and cure the trouble promptly. Is not this the one thing above all others which enabled America to play so important a part in the war? Was it not the spirit of the engineer, his capacity to do things and do them quickly? Surely the war was not won by money, for the enemy was never financially embarrassed.

I think we shall all agree that the basic strength of the Allies throughout the war was in the never-dying morale of all the people, including the armies, arraigned against Germany. But what would this strength have availed us but for the resources behind the lines. Modern war resources are mainly coal and iron and the capacity to put these things to practical use on a large scale. The mines would avail little but for the works, and the works might avail little but for the men, the engineers who direct them on modern, scientific lines of high efficiency.

And so America, through its engineering and industrial strength, helped to save the world from calamity. Now what individual best exemplifies this? Food played an important part in the war. We have heard the cry that food will win the war. Surely, without food no war could be won. It was Mr. Hoover who took care that there should be no food shortage. He did more—he taught thrift to millions of people in all walks of life and in all parts of the world. He preached the gospel of the clean plate. But it is not only in food that our guest stands as an example of achievement; he typifies the engineer, the executive, the man behind the gun. It is easy to see things that lie directly before us, but the best executive is one who builds his fences around the future, who anticipates trouble before it comes.

The Construction of Portland Cement Concrete Pavement Foundations

By James W. Routh Director, Rochester Bureau of Municipal Research, Inc., Rochester, N. Y.

The foundation of any structure is the most important part of that structure. This holds true as well for a pavement as for a bridge, yet in the majority of cases all attention is paid to the wearing surface and scant attention to the foundation. Even the national engineering societies in their specifications pay little heed to the method of designing and constructing the foundation courses of pavements. As a result many pavements which otherwise would give 18 or 20 years of excellent service last less than half that time. It is the expressed opinion of leading pavement engineers who have been consulted on this point that more than 50 per cent. of pavement failures are due to failure of the base in the first instance.

Base failure may result from three causes, all of which are more or less controllable: First, the subgrade may be at fault; second, the concrete base itself may be carelessly and improperly constructed; third, pavement cuts made after the completion of the pavement may be improperly replaced. Each of these causes for pavement failure will be discussed in the present article.

The Subgrade

The subgrade actually carries the traffic load. Failure of the subgrade means failure of the pavement. Hence, it must be carefully prepared and thoroughly compacted throughout, and reinforced where necessary. The purpose of the concrete foundation is to reinforce and distribute the load over the subgrade.

Underdrainage

Much has been said and written about the importance of properly underdraining state roads and highways in general. It is necessary in discussing the problem of city pavement construction to repeat some of the things said so frequently in connection with highway construction.

Underdrainage is essential, and underdrains must be so installed as to function properly. In many cases where farm tile are laid back of the curb it is found that careless work methods are responsible for clogging the drains before the pavement is completed, and, in other cases, no effort is made to connect the drains with sewer inlets. A further source of difficulty with this type of underdrainage comes from the practice of public utility companies in opening pavements after they have been built, removing sections of the under drainage system in order to make service connections to houses, and then failing to replace the tile.

Many of the difficulties encountered in controlling the use of farm tile may be practically eliminated by substituting the use of bell jointed vitrified pipe of small dimension. Pipe is available in sizes as small as 3-in., and where it has been used has proved very satisfactory. This type of underdrainage is more easily laid than farm tile, the pipe being laid with open joints, and it has been found that when excavations are made for service connections the pipe usually will support itself in place. This relieves, to some extent, the uncertainty of the utility company making proper replacement.

Whatever type of underdrainage is used, the pipe or tile must be laid carefully to line and grade and in coarse gravel or

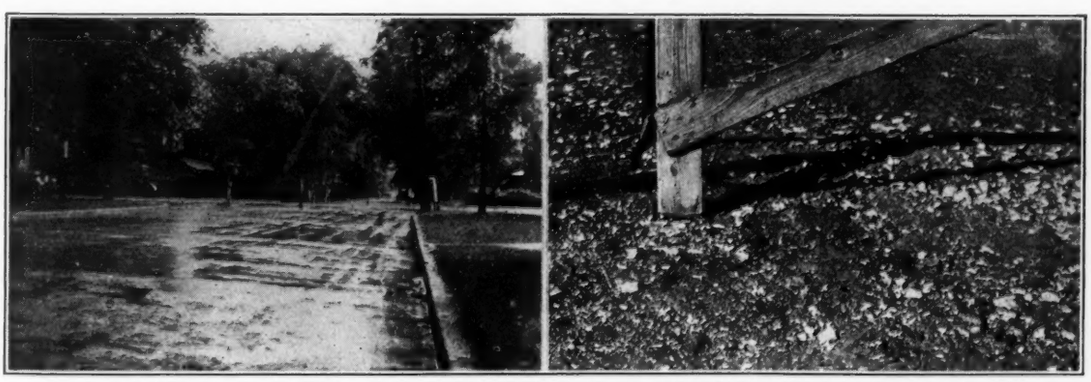


FIG. 1. LAYING CONCRETE ON A BADLY RUTTED SUBGRADE MAKES FOR UNEVEN BASE THICKNESS. FIG. 2. AN UNEVEN SUBGRADE FREQUENTLY MEANS AN UNEVEN, POORLY DRAINED CONCRETE BASE.

crushed stone. To fill in around it with bank run gravel or sand simply means that the drains will be clogged at the first rain and will not function thereafter. Of course the drains should be connected with all sewer inlets, and, where necessary, directly connected with the main sewers.

Other Precautions

The subgrade itself must be carefully worked over in order to prove satisfactory as a bearing area for the pavement. All vegetable matter and soft spots which cannot be compacted by rolling must be removed and replaced with suitable material. Then the entire subgrade must be thoroughly tamped or rolled. If settlement occurs, the depressions should be scarified, filled and rerolled until the surface is solid, uniform and parallel with the grade of the finished pavement.

When the subgrade is composed of material that cannot be made stable by ordinary means, sometimes draining excess moisture from it by the use of transverse trenches is effective. Such trenches generally are made about a foot in width and depth, and extend entirely across the subgrade. In the bottom of the trenches vitrified drain tile are laid with open bell joints so as to slope from the center of the street to each curb and to connect with the curb drains. The trenches then are filled with coarse gravel or crushed stone and compacted by light tamping. It is important that the trenches be kept free from dirt until concrete can be laid immediately on top of the crushed stone.

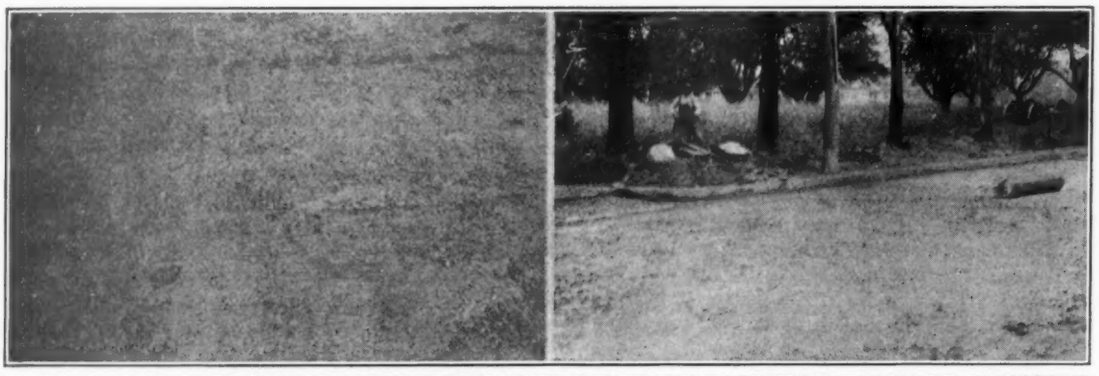


FIG. 3. THE BASE SHOWN IN FIG. 2 RESULTED IN AN UNEVEN FINISHED ASPHALT PAVEMENT. FIGS. 1, 2 AND 3 INDICATE HOW AN IMPROPERLY PREPARED SUBGRADE MAY PRODUCE IRREGULARITIES THROUGHOUT THE PAVEMENT STRUCTURE. Fig. 4. THE ROUGH IRREGULAR SURFACE OF AN IMPROPERLY FLOATED CONCRETE BASE.

The Concrete Base

The proper base thickness for any street will depend upon sub-soil conditions, character and density of traffic, and kind of wearing surface. When unstable sub-soil conditions are encountered, extra base thickness is necessary. Given a substantial subgrade, however, it is believed the following base thicknesses for plain concrete are economical and sufficiently substantial:

I—For main, heavy traffic thoroughfares:

(a) Bituminous wearing surface, 10 ins.
(b) Monolithic or semi-monolithic brick or stone block surface, 8 ins.

II—For intermediate thoroughfares, subject to a moderate amount of heavy traffic:

(a) Bituminous wearing surface, 8 ins.
(b) Monolithic or semi-monolithic brick or stone block surface, 6 ins.

III—For major residential streets, carrying light weight thorough-traffic and few loads over 10 tons:

(a) Bituminous wearing surface, 6 ins.
(b) Monolithic or semi-monolithic break wearing surface, 5 ins.

Strictly minor residential streets, not likely to develop into other than local traffic streets, of course, will not require even as heavy construction as Class III. For such streets, base thicknesses as little as 4 ins. may be used with safety.

In considering the foregoing, it should be held in mind that a classification of streets can be accepted with safety only when based upon knowledge of present and probable future traffic conditions and protected by a proper city plan, including "use" districts or zones.

In addition, of course, soil conditions must be known. Under such conditions, it is believed that more experimental data relative to the influence of soil bearing values and load weights and frequency on pavement thickness, may indicate the possibility of using even thinner concrete bases. More complete data of this kind are much needed.

Careful Construction Important

The mixing and placing of concrete in pavement foundations is a matter all too generally given little attention. It is believed that if a concrete base is properly made it should last through one or more resurfacings, and thus make for better economy in street construction. To accomplish this it is necessary that the foundation course be considered almost as a pavement in itself. The concrete for such a base should be somewhat richer than the ordinary 1:3:6 mix. A 1:2½:5 mix has proved to give better results and to be little, if any, more expensive.

It is not thought necessary to discuss the constituent parts of the concrete. The cement, sand and coarse aggregate should all be of the same high quality demanded in other foundation work. Laboratory control over proportioning is essential, and of course all materials should be subject to test before acceptance.

Consistency and Thorough Mixing

The consistency of concrete for pavement foundations is an important matter. It requires constant attention from the inspector, especially when spot mixers are used. Excessive water is as detrimental to concrete in a pavement base as it is to that in a building. The use of boom and bucket mixers, properly graded coarse aggregate of fairly small maximum size, and thorough mixing, aid greatly in obtaining good concrete. Spot mixers generally have so little slope to their spouts that it is difficult to get concrete of a proper consistency to flow out. The use of fairly small stone and the insistence upon thorough mixing (at least one minute in the drum), result in concrete of a mushy consistency being easily workable and reasonably easy flowing.

In many cases the inspector or engineer can aid the contractor in speeding up his work without shortening the mixing interval. Time studies of concrete gangs on city street work indicate that much lost time results from lack of proper control over separate operations. The placing of materials conveniently, the routing of wheelers, and the proper direction of loaders require careful attention. It is poor economy to shorten the mixing interval to a few seconds and

then hold the drum empty for two or three minutes because of delays in filling the hopper. That thorough mixing actually makes for more workable, as well as better, concrete can readily be demonstrated.

Placing and Shaping

The placing of concrete is facilitated by the use of boom and bucket mixers. With this type of machine each batch can be placed directly where it is needed, with the result that the minimum of pulling over is required. Whatever type of mixer is used, however, it is important that proper means be provided for shaping the base section. In streets of 28 ft. width or less, it is possible to use a template or strike board extending across the street and resting upon each curb. Such a strike board should be shaped to the crown of the street and when manipulated across the freshly placed concrete should leave it at the proper elevation and in the proper shape for the finished pavement. The use of reasonably small stone has been found to facilitate the use of a template in the wider streets.

In streets of 30 ft. or more in width, pins can be used to guide the shaping of the base. Iron pine provided with 2 in. rings at the top are desirable. The ring serves as a guide for elevation and provides means for pulling the pin out after the concrete has been placed. When the pin method is used, however, it is more difficult to get a uniform crown than when the template is used. This means that the inspector must watch the shaping of the concrete much more closely than is necessary when the other method of shaping is in use. A lop-sided crown on the base means a lop-sided crown on the finished pavement, with all of the consequent ills.

Use of the Roller for Finishing

After the concrete has been placed and roughly shaped, the pavement base must be floated in order to obtain a uniform surface and density. The use of a roller for this purpose gives excellent results. The roller has been developed for use in the construction of concrete roads, but as applied to concrete bases in city streets, it is equally effective, ensuring uniform density with a minimum of physical effort. Contractors who have been persuaded to try this method of finishing concrete, find considerable economy in man-power to result. They also find that the resulting concrete surface has sufficient uniform roughness to serve as a base for bituminous wearing surfaces. (A smooth surface for block pavements may be obtained by following the roller with a belt).

When the roller is used in city streets having curbs, it is necessary to float, with the back of a shovel or a wooden tamp, the concrete immediately adjacent to the curb and extending out some 18 ins.

Curing

After placing and floating, ordinary practice has been to allow the concrete base to take care of itself. Proper curing, however, is as important for a pavement base as for concrete in any other structure. A concrete base should be considered as a concrete pavement in all essentials except richness of mix. Proper curing requires that concrete be kept damp for a period of five days after placing. This can be accomplished by ponding in level streets or by spraying with the hose at regular intervals each day. Of course when a block pavement with a sand cushion is to be laid, the sand can at once be spread on the green concrete and kept damp.

Pavement Cuts

Proper care in the preparation of the subgrade and construction of the concrete base will go far toward preventing foundation failures, but if public utility companies are allowed to make pavement cuts without regulation, no pavement can be expected to last. Every cut weakens the pavement structure, no matter how carefully the replacement may be made. It is believed important that utility companies be prohibited from opening pavements for a period of five years after construction. To accomplish this a permit with the payment of a relatively high fee should be required before cuts are permitted. The most effective way of preventing pavement cuts, however, is to place all substructures on the sides of the streets in the sidewalk or planting strip area. It is believed that when the economics of the problem are fully understood, this will become a general practice in all new streets.

Whenever pavement cuts are allowed, the cutting and replacement work should be done under the supervision of the city's engineering organization. The backfilling of trenches in particular should be carefully watched. Mechanical tamping is effective in such cases. As a general rule flooding should be avoided, because of the danger of saturating the filling material so it will not dry out.

The recommended practice of requiring the concrete in the original base to be cut back a foot or more from each side of the trench to provide a proper bearing area for the replaced slab, is believed excellent. Double thickness of concrete or reinforced concrete over trenches also should be required. Every precaution should be taken to ensure satisfactory replacement and reinforcement of the pavement that is bound to be weakened by the cut.

FIG. 5. THE SURFACE OF A ROLLER FINISHED CONCRETE BASE. FIG. 6. OPERATING A ROLLER ON A CONCRETE FOUNDATION TO BE COVERED WITH AN ASPHALT PAVEMENT.

Systematize Motor Truck Express Lines to Reduce High Cost of Living

By E. A. Williams, Jr., President Garford Motor Truck Co., Lima, Ohio

Systematic organization of motor truck express lines already in operation and intelligent inauguration of new routes will afford at least a partial solution to the present high cost of living problem according to men prominent in industry and commerce.

Lack of adequate transportation is one of the chief reasons offered for the present crisis. In many cities, government and state officials are investigating food waste which, according to

the commission men, may be traced directly to transportation delays.

There are numerous instances of commission firms having been indicted for the wholesale disposal of food-stuffs, which, the commission-men claim, were delivered by railroads in unsalable condition.

Efficient organization of the motor truck lines in various communities with the idea of eliminating the possibility of idle trucks and light return loads will go far toward solving this transportation problem and reducing transportation costs, in the opinion of many who have given this phase of the matter careful consideration.

To obtain maximum returns from motor truck transportation, the numerous lines now operating should be systematically organized. Without a unity of purpose there is a capacity waste in every community. This naturally results in a loss of tonnage and increased costs. It has been said that 70 per cent. of the motor trucks operating in the United States during 1918 traveled empty one way. From these figures it was estimated there was a capacity waste of 283,500,000 tons during the year.

With the establishment of highway transportation commissions in the various states and the organization of transportation bureaus in many of our cities this tonnage waste is being eliminated. In several cities the haulage concerns have formed associations and have established central offices from which the motor truck transportation activities of that particular community are directed. These associations are affiliating with associations in nearby cities in order further to decrease the possibility of idle trucks and light return loads and to increase the general efficiency of the service.

The motor truck actually has become a public utility in many localities. Entire communities are depending upon it as a means of supply. It has become equally as essential as the railroad and waterway.

To obtain maximum efficiency, the transportation units of the country—the railway, waterway and highway—should be linked up systematically. More highways should be built, the present highways improved and a greater number of motor express lines touching those sections not reached by either rail or water, should be created.

That such a system would have important bearing upon reducing the cost of living essentials is apparent. Available government figures show that in 1919 the cost of shipping by truck throughout the country was from 10 to 30 cts. per ton-mile lower than the cost of horse-drawn vehicles. One can at least imagine what this will amount to in a year.

Speakers before a recent convention of retail and wholesale grocers in Toledo voiced the opinion that their hope of reducing prices lay in the motor truck. Practically an entire session of the convention was devoted to this phase of the transportation problem which they deemed highly responsible for the present high costs.

One speaker, an officer of the grocers' organization, declared that the motor truck held the actual solution to the problem. This recognition of the motor truck as a transportation factor, coming from men who analyze and understand conditions governing the markets is noteworthy and should be taken as convincing proof of its worth.

Some Problems Confronting Municipal Engineers in England

By Charles Brownridge, Borough Engineer, Birkenhead England.

(The strain of the war on England was so much greater than on the United States that it is of interest to American municipal engineers to read what a British municipal engineer has to say on the above topic. What follows is from the presidential address delivered before a conference of engineers and surveyors held in connection with the Royal Sanitary Institute Congress at Newcastle-on-Tyne—Editor.)

With the conclusion of the war there is much leeway to be made up, and arrears to be made good, and it is very desirable that—having regard to the altered conditions which now exist—we should closely consider how we can in future best plan and carry out our work, and what improvements in our methods we can with advantage adopt.

In work connected with the war all branches of science were organized for one common aim, and I would express a hope that this principle should not be altogether abandoned, but that the system should, at least in part, be retained and continued, with its energies directed now to investigation and research for the improvement of the health and welfare of the community, and that the State should, either by direct action or generous subsidy to the laboratories of the various universities, foster and encourage experiment and research in order to ascertain the best methods and appliances to adopt to prevent and stamp out disease, and to discover new, and improve existing, materials and methods used in construction work.

The Supply of Materials

With reference to materials, we have in the past, while endeavoring to do our best with those to hand, been too content to accept the materials available. I feel sure that if the energy and ability of our chemists were directed in the right channels, they would be able to give us many improved and alternative materials suitable for our work, and devise methods to increase production and cheapen the cost of manufacturing or producing existing materials.

As engineers we would welcome the discovery of a cement having the combined merits of Portland cement and bitumen, and satisfactory substitutes for wood, stone and bricks. I feel sure that, although the bricks at present manufactured are excellent, cheaper methods of manufacturing and burning could be devised.

Any and all efforts to insure good buildings being erected and new work carried out at a reasonable cost will be to the material advantage of the state, and enable us to carry out more quickly the many and various works that are so urgently required, and so necessary in connection with our municipal work, to make our people healthy, and to keep them healthy and happy in the future.

The past has taught us many lessons from which we should now profit, and we should now, by taking a wide and generous view, so shape and design our work as to look well ahead and not only provide for the present, but have due regard to the changing conditions now existing and the consequent probable requirements of the future.

Labor Difficulties.

The wave of industrial unrest now passing over the country is seriously affecting the work of our municipalities, and it will be necessary that we should carefully consider and review the position with a view to best overcoming the serious labor shortage existing, and adapting our conditions to meet the higher wages now ruling.

It is to be regretted that workmen, while justly and properly taking all means to assert their rights, do not in very many instances appreciate that they have in addition also their duties to themselves, their families, their work and to the State.

Good wages can always be justified if supported by good labor, but the present irregular time-keeping of many of our workmen is causing serious unnecessary difficulties and waste to arise. In my own case, I regret to say that since armistice day there has been among the men employed under my direction an average daily absenteeism exceeding 10 per cent., often causing necessary sanitary duties to be seriously prejudiced and affected. Unfortunately, this irregularity not only affects the work which should be done by those absenting themselves, but in many instances disorganizes and interferes with the arrangements necessary to be made in connection

with all work, and causes serious loss and waste of time. If any steps can be taken to stabilize labor and make its service dependable—subject, of course, to justifiable absence owing to sickness—it would, I am sure, be welcomed by all having the charge and direction of work.

Use of Machinery Necessary.

It will be necessary on financial grounds for the engineer carefully to consider what machinery and appliances can be installed to cheapen and expedite work, and to foster and further the employment of mechanical appliances for all work in which it is possible for it to be suitably and beneficially used, especially that which will tend to reduce the employment of unskilled labor, as, with the universal advance in education and learning, this branch of labor should be reduced to a minimum and its present members transferred to and trained in some branch of the arts and crafts.

The extent and character of the use of machinery in our work in future will no doubt be considerable, and its form and design offer a wide field to the ingenuity of the inventor, and, as progressive engineers, we should do all we possibly can to further its application and foster its invention. Most municipalities have already found it both economical and advisable to adopt mechanical haulage, and are considering the introduction of machines for the combined sweeping and collecting of refuse from the streets, and for excavating, filling and ramming trenches; a more extended use of mechanical mixers for concrete and tar-macadam; a more general adoption of mechanical means for lighting and extinguishing lamps and other numerous mechanical devices will be found necessary and desirable.

Institution Sparing no Efforts.

The work of the municipal engineer is most wide in its scope, of a most varied character, and its duties onerous, calling for unremitting attention, care and thought, and it is therefore fitting that the Institution of Municipal and County Engineers are sparing no efforts to ensure that its younger members shall be properly educated and trained for their work, and have every facility for this purpose, and further to ensure that local authorities should only appoint properly trained engineers and surveyors at a proper and adequate salary; and, having regard to the great effect the work of the engineer and his assistants has on the prevention of disease and the comfort and health of the community, this excellent work will no doubt bear good and valuable fruit and enable the members of our profession to direct their endeavors in the most effective and productive way to carry on their duties.

Macadam Construction on Primary and Secondary Feeder Highways

By W. C. Buetow, Division Engineer, Wisconsin Highway Commission, La Crosse, Wis.

As we think about our highway problems we picture in our minds a system of highways. The outline of the counties stands out plainly and within the borders we see wide bands crawling in different directions, like the main branches of a tree. These are the main arteries of travel and the surfaces are of the higher types, concrete and brick. From these main arteries we see other roads, with their feeders, crawling away, carrying lighter travel and bringing traffic from the remotest part of the county to the business centers. Each county has its own picture to draw, depending on the amount of travel passing over the roads. We are now considering only the more lightly traveled roads, starting with the primary feeders emptying their travel onto the main highways surfaced with either concrete or brick.

Primary Feeders.

Primary feeders may be constructed of bituminous macadam either by the mixing method or by the penetration method, said Mr. Buetow in addressing the annual road school. The foundation for the wearing surface is the same for either road. The thickness depends on the nature of the subgrade. The size of stone usually used is the same as the No. 1 stone of a waterbound macadam, stone passing a 3½-inch ring and retained on a 2½-inch screen. Spreading and rolling are the same as for the ordinary macadam work. However, the base course is filled with sand or screenings and, if deemed necessary, flushed with water to make it firmer. The reason for filling the base course is to make the base firmer and to prevent the bitumen from running down into the voids, thereby wasting the bitumen and drawing it away from the wearing surface where its presence is very essential.

It is not essential that a detailed description be given of the various steps of the mixing method, because of the plant involved. Briefly the method is this: The stone and bitumen are mixed hot in a specially prepared mixer at either a stationary or portable plant. Even with a portable plant it may be advisable to set up at the stone pile and haul the mixed product to the road. The mixed material must be delivered on the road hot so that it can be spread evenly and properly rolled. Even spreading and proper rolling are extremely important. Great care must be exercised that the bitumen is not burned because that particular batch will fail in the pavement.

Penetration Method

The penetration method requires less expensive equipment and for that reason a more detailed description will be given. Having the base prepared, the surface stone is carefully spread so as to get a uniform thickness. Here, as in waterbound macadam work, the stone should not be dumped in a pile and then shoveled over the required area. Dumping stone in piles compacts the bottom and allows the coarse stone to roll to the sides. This gives the surface an uneven density.

Size of stone depends somewhat on the thickness of the wearing surface and the hardness of the rock. The size usually ranges from 1¼ to 2½ inches, but may run slightly larger for soft stone and finer for the harder rocks like trap and granite. Uniformity is an essential requirement and great care must be exercised to see that the material is clean and free from dust and dirt.

Rolling The Rock.

Rolling the rock is done with an ordinary road roller of ten tons weight and in the same manner as in waterbound construction. Too much rolling can be done on the softer rock. All that is required for soft stone is to shape the road and lock the stone. The surface should be open to admit the bitumen, yet not so open as to allow the binder to pass through the base course. The bitumen is a binder and must get between the stones and thoroughly coat them. If the roller crushes the rock too much, closing up the voids, such spots must be removed, otherwise the bitumen lies on top as a mat only to peel off, leaving a bare and weak spot in the surface. Hard, rock-like granite cannot always be locked without the addition of ¾-inch keystone. In addition to locking the stone, the ¾-inch chips reduce the voids and prevent the binder from passing through to the base course.

Applying the Bitumen.

Having the stone properly rolled, the surface is ready for the bitumen. It is not necessary to go into details about how hot the asphalt is applied, because different products require different spreading temperatures. Nevertheless the binder must be properly heated and the stone must be dry.

About 1.5 gal. per square yard is required for the first application and it must be evenly applied so that each square yard gets the specified amount. As the work progresses, whether the binder is applied by pressure wagon or by hand, the application should be checked to see that the bitumen used has covered the required area.

When the first application has been put on, the surface should have a uniform black appearance and the spaces between the stones should be open. Stone chips, ¾ inches in size, or whatever size is necessary for the size of the voids, are now spread evenly over the surface in just sufficient quantity to keep the roller from sticking. The road is again rolled, forcing the chips into the voids. All excess material is now swept off and the road is ready for the second application. If considerable excess material is allowed to remain on the surface, the second application of binder may not adhere properly to the road and will peel off. The second or seal coat of about 0.5 gal. per square yard is now applied and must be spread evenly. As soon as the bitumen is on, the surface is covered with stone chips or pea gravel and a final rolling prepares the road for travel.

In either of the methods, uniformity is the keynote. It is highly important that the size of stone be kept uniform, that the temperature be uniform, that the materials be placed uniformly and that each course gets uniform rolling.

Secondary Feeders.

So much for the primary feeders. The secondary feeders, or the feeders to the primary roads, are the still less traveled roads in the highway system. For these the modified penetration is applicable. The so-called modified penetration calls for lighter asphalts and tars than those ordinarily used for surface treatments. These light products do not have to be heated.

The base course of the so-called modified penetration macadam road is no different from that of the plain waterbound macadam construction. In the case of the soft limestone, there is enough locking due to the crushing action of the roller, and the small pieces broken from the corners of the stone during the rolling fill the voids to some extent. This is not true of the harder stones like trap and granites; the base course must be filled with clay, sand or screenings. Clay is a good filler and if not used to excess it can be drawn up to help bind the second course. It should not be drawn up more than half way into the second course because asphalts and tars will not stick to dirt. Whether the base course is filled with clay, sand or screenings, or whether it is left open, the stone must be thoroughly rolled, because the screenings are not flushed in from the second course as is the case in the waterbound road.

The Second Course Stone.

When the base course is in shape, the second course stone is spread and rolled. Success or failure of the work lies in locking the second course, and this must be mainly brought about in the rolling, because the light oils do not have the cementing properties of the heavier binders used in the mixing or penetration methods. Locking the stone by rolling applies particularly to the softer stone and is not true of harder rock like granite. Too much rolling of the soft rock is worse than not enough, because the crushing and grinding action under the roller wheels will make the surface too dense. Excessive rolling of hard rock tends to smooth it up, making it that much harder to bind. During the rolling it is essential to see that voidless spots do not develop. If any occur, due to crushing the stone or from material improperly screened, they should be raked out and the holes filled with clean stones. A uniform surface is necessary and any spots filled up tight before the oil is applied break up the uniformity and leave weak spots in the pavement.

At this stage the surface is very porous and if the bitumen were applied it would run through to the sub grade. An enormous amount of oil would be required to fill up the surface, besides making it soft and spongy. To keep the stones from shifting under travel, the voids must be partially filled before oil is applied. The screenings must be applied evenly and when dry. The roller is operated over the road during this process and shakes the dry screenings into the voids. There should be several steel push brooms on the job so that the uneven patches of screenings may be spread properly. Screenings should be applied until the voids are about filled, giving the surface a mottled appearance. The first application of 0.5 gal. of road oil is put on by a pressure distributor. The force of the spray cleans the fine dust off the exposed stone, besides forcing the screenings further into the voids. Spots that are impervious will show up very plainly after the oil is applied, presenting smooth, glossy, unbroken surfaces. These places, if not removed, are getting but a surface treatment rather than being impregnated. Consequently these spots do not have the same wearing qualities as the balance of the pavement and in a short time bald spots appear. Should such appear after the road is opened to travel, immediate attention should be given them because such a spot grows rapidly in size and depth.

Screenings.

After the first oil is applied, a light coat of screenings should be spread and followed up with the roller. If the surface was properly filled before the oil was applied, there will not be enough oil in the road to cause roller wheels to pull up patches of the surface. If there should be too much oil, the only thing to do is to let the road stand as it is for a day or two, giving the oil a chance to soak in. If allowed to stand too long, a light application of oil may be necessary before additional screenings are put on. The roller brings the oil back to the surface and bonds or mixes the screenings in. A second application of 0.5 gal. of oil is given the surface and followed up with a heavier course of screenings. The second coat of screenings can be heavier than the first because the oil will not soak in so much. The roller will again bring the oil to the surface and mix it with the screenings. The surface should now be well filled up, if not, a third application of 0.125 gal. per square yard is applied. Clean stone chips or torpedo sand are better for the finish coat.

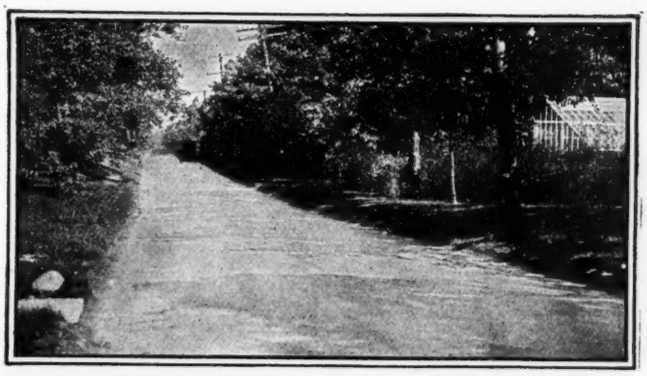
When granite or trap rock is used, and its screenings are used for filler, it is quite necessary to use ¾-inch keystone to help lock the second course. The hard rock does not absorb the oil as the soft stone does and consequently the oil is drawn to the surface more readily. If screenings are added in sufficient quantity to keep the rollers from pulling up patches, there is danger of getting too much material on the road, causing the surface to flake under the action of the roller. Should this happen, a light sprinkling of ¾-inch stone must be applied and rolled in, otherwise the horse traffic will chop the flaky spots to pieces, causing holes to form.

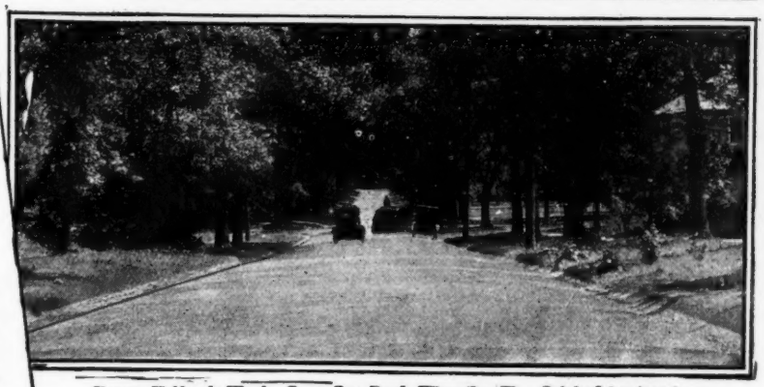
No matter what material is used, soft or hard rock, care must be taken that a thick mat of oil and screenings is not formed on the surface. After the road is finished, it should be allowed to stand for several days before traffic is allowed to use it. Automobile traffic is a benefit to this type of road because the pneumatic tires iron out the surface. If there are places which look as if there were not enough oil, the chances are that after the road has been open to travel for a few days, the oil will be drawn to the surface, giving it the appearance of a sheet asphalt pavement.

It is very doubtful to my mind if we should build any more waterbound macadam roads. If they are built they must be surface treated immediately. Then you will have paid for watering and oiling the road, while, if the modified penetration method is used, the watering cost has been eliminated. In addition to this, the oil is incorporated in the surface and not merely lying on the surface as is the case in surface treated work. The results obtained by the modified penetration method have placed the waterbound macadam in the class of the "has beens."

Tarvia

Preserves Roads
Prevents Dust~





Upper—Hubbards Woods, Green Bay Road, Winnetka, Ill. Original treatment, "Tarvia-A" over macadam in 1907. Kept in prime condition up-to-date with the same material.

Lower—Elm Street, Winnetka, Ill. Scarified and treated with "Tarvia-A" and granite chips in 1917.

What Winnetka thinks of Tarvia

THE VILLAGE OF WINNETKA
WINNETKA, ILLINOIS.

November 18, 1918

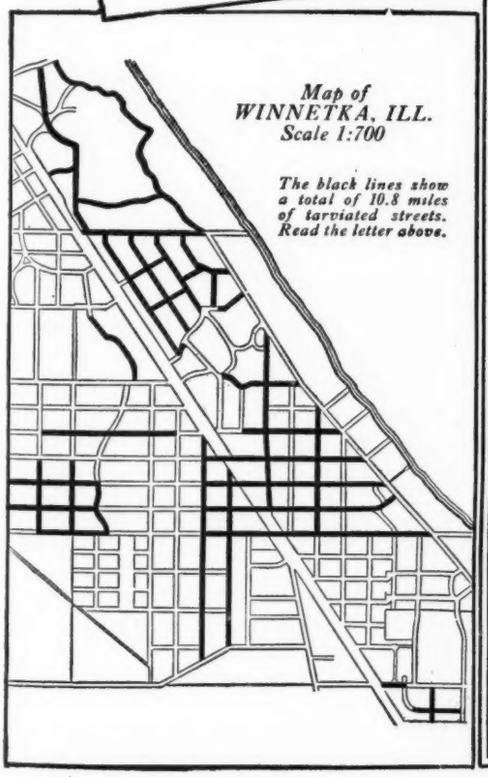
The Barrett Company
Chicago, Ill.

Dear Sirs:

Two years ago this municipality adopted the policy of resurfacing all macadam streets within the village limits with "Tarvia-A" and granite chips. Inasmuch as the close of the present season finds the program practically completed, we wish to take this opportunity of thanking you for your very excellent service in meeting our requirements, and to express to you our judgment that this method of maintaining macadam streets in high-grade condition is most satisfactory from the standpoint of economy, good appearance and durability.

Yours very truly,

THE VILLAGE OF WINNETKA
(Signed) H. L. Woolhiser
Business Manager



Map of
WINNETKA, ILL.
Scale 1:700

The black lines show a total of 10.8 miles of tarviated streets. Read the letter above.

How Winnetka, Ill., obtained beautiful streets at low cost

A FEW years ago Winnetka streets were much like those of hundreds of other villages to be found all over the country—beautiful homes on both sides, separated by muddy roads in wet weather and clouds of dust in dry weather.

Then the Village Council got busy. The property owners were canvassed and asked to contribute part of the cost of a good roads program.

The result was 5.8 miles of Tarvia streets laid during the first year, a third of the cost, amounting to 15 cents per front foot of the abutting property, being paid by the property owners and the rest by the village.

Last year all the rest of the macadam streets were tarviated, so that today Winnetka ranks among the best-paved villages in America.

Up-to-date municipalities and road authorities use Tarvia—

—because it gives durable, all-the-year-'round roads at the lowest possible cost; because Tarvia roads are dustless, mudless and frost-proof; because they stand up under severe motor traffic; because they quickly pay for themselves in reduced maintenance costs.

That is why Tarvia is the standard road-making material in most American communities.

Write for illustrated booklet and further information.

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A Small, Portable Heater for Use of Highway Maintenance Patrolmen

A small, portable heater, for heating tar and other bituminous materials used in highway maintenance work, has recently been designed and placed on the market by Littleford Bros., 460 E. Pearl St., Cincinnati, Ohio. It is called the Littleford Patrol Heater No. 68 and is here illustrated. This heater was designed especially for use in connection with the patrolling system which is being rapidly installed by state and county road departments. With this outfit the patrolman or operator, covering a limited mileage, is in position to make patches immediately after the road shows signs of wear. It is durably constructed of sheet steel, not too heavy, and

NEW PORTABLE HEATER FOR USE OF HIGHWAY PATROLMEN.

the design is such as to make it easily handled by one man. The fire box is fitted with cast iron grate and hinged fire door. The welded kettle rests entirely within the fire box and is removable; it has a capacity of 8 gals. As soon as a concrete brick or asphalt road cracks or shows signs of wear or disintegration, the patrolman takes this kettle and with a supply of crushed stone or gravel makes repairs that arrest the deterioration of the roadway. This is the proverbial "stitch in time."

Personal Items

The Kelvin Engineering Co., Inc., Mr. Gustavo Lobo, President, Engineers and Contractors, 32 Broadway, New York, have organized a new department to do general engineering and contracting work in this country and in Latin America. This department will be in charge of Mr. Carlos Lobo, M. A. S. C. E., formerly Borough Engineer, Department of Water Supply, Gas and Electricity, Borough of Brooklyn, New York. The Company will continue its existing business of designing and manufacturing sugar machinery and machinery for various industrial purposes and its business of export of machinery of all kinds, sugar, electrical, industrial, etc., to Cuba, Mexico and other Latin American Countries. In addition, the Company is now prepared to execute contracts for furnishing and erecting sugar, electrical and industrial machinery and equipment and for the design and construction of water works. The Company also, in conjunction with the Nazareth Foundry and Machine Company, are equipped to manufacture all types of castings and to do all kinds of steel plate and machine work.

Mr. Walter E. Rosengarten has resigned his position as Highway Engineer in the United States Bureau of Public Roads to accept the position of Traffic Engineer with the Asphalt Association and will make his headquarters at 15 Maiden Lane, New York. At his new post Mr. Rosengarten will deal with the very difficult and pressing problems of coordinating the design of the various highway types with the requirements of modern traffic. In specializing along these lines the Asphalt Association has shown its appreciation of the fact that the traffic of America's 7,000,000 motor vehicles including some hundreds of thousands of heavy trucks calls for a keen and appreciative study of the forces which on the one hand tend toward the deterioration of the highway and on the other hand toward increasing operating costs and the deterioration of the motor vehicle itself. Mr Rosengarten is particularly fitted for his new post by reason of the fact that since his graduation from the Engineering Department of the University of Pennsylvania he has had a combination of practicable highway construction experience and research study with both the University of Pennsylvania and the U. S. Bureau of Public Roads. He was with the Federal Bureau about eight years during which he spent about four years in practical highway construction, and about two and a half years in the research and testing division in connection with laboratory and field work.

Captain Robert B. Murdock, who has recently returned from military service in France, has been appointed executive engineer with the Asphalt Association at 15 Maiden Lane, New York. He will directly assist the secretary of the association in developing the organization and operating policy. Captain Murdock has had an extensive experience in practical highway work during the course of which, as resident engineer, he had charge of the construction of one of the most difficult portions of the Columbia River highway including the famous figure "8" section at Crown Point, near Portland, Oregon. Later he was made Assistant State Highway Engineer of Oregon and held that office until he entered the military service.

The City Engineer of Barcelona, Spain, Professor Jose Me de Lasarte, Dr. Sc., has lately been in the United States as the Representative of the Section of Education of the Congress of Engineers, which is to take place in Madrid, Spain, during the month of October. Dr. Lasarte is well known as a Municipal Engineer in Barcelona, and is also a writer of some note and a Professor of the University of Barcelona. Just previous to his departure for Barcelona on September fifth, he received a cablegram from the President of the City Council of Barcelona, asking that arrangements be made for the technical reports of American municipalities to be sent to the Ayunteamiento de Barcelona; Consejo de Cultura, Barcelona, Spain, (The City Council Development Committee) in order that they might become more familiar with American practice in municipal work. Municipal engineers in this country should note the desire of Barcelona to receive the official publications of American municipalities on an exchange basis. Foreign cities are very appreciative of such courtesies.

Trade Notes

The Philadelphia Vitrified Brick Company, Philadelphia, Pa., has engaged in the manufacture of wire-cut lug paving brick under license contract with The Dunn Wire-Cut Lug Brick Company of Conneaut, O. The eastern works of the company are at Saxton, Pa. Charles D. Ames is president of the company and J. T. Hawthorne is secretary and treasurer. The addition of the plant of the Philadelphia Vitrified Brick Company makes 75 plants licensed to make wire-cut lug brick in 12 states.

WATER WORKS SECTION

Proposed Water Filtration at Detroit, Mich.

As a result of a recent report on an investigation of the Detroit water supply with reference to filtration and other improvements, definite progress toward construction is now being made. The report was made by R. Winthrop Pratt, Consulting Engineer, Cleveland, Ohio. The present article is based on the report and on developments subsequent to its delivery.

The investigation was made for the purpose of obtaining accurate data relative to the quality of the Detroit water supply and determining the maximum rate at which the water could be filtered, consistent with safe and satisfactory results. An experimental plant was therefore constructed and operated for one year begining Oct. 1, 1917.

Experimental Filter Plant

The experimental plant is, in addition to being of strictly technical value, serving also to create interest in filtration on the part of a large number of residents of the city who made a practice during the warmer months of carrying away the filtered water in bottles. Special facilities were provided for filling these bottles without interfering with operation of the plant.

At the same time there were prepared a set of general drawings of a 300-million gallon filtration plant, these drawings being in sufficient detail to permit a fairly accurate estimate of cost to be made and at the same time to serve as a basis for construction or contract drawings.

The filtration of Detroit River water is of course considerably easier than filtration of most of the existing supplies; and the results show that it is possible to filter the water through relatively coarse sand at the rate of approximately two hundred million gallons per acre per day, using less than one-tenth of one percent wash water. The bacteria in the raw water, during the year of operation which averaged 37 per C.C. (37° AGAR) were reduced to 6 per C.C. without using any sterilizing agent. All turbidity and practically all B. Coli were eliminated.

The results of the investigations, together with some general data relative to filtration, were printed in a report which was distributed by the Detroit Board of Water Commissioners to a large number of interested citizens. This report also contains reproductions of the general plans. The following are the Summary and Conclusions of the report:

Summary and Conclusions

Analysis of Detroit's municipal water supply, a survey of parallel experience in other cities and the experimental purification of Detroit's water on a small scale for one year have been instituted to determine what type of purification plant and what methods of operation are best calculated to improve the quality of Detroit water.

The report comprises chiefly the results of operating an experimental plant and their application to the design of a filtration plant of the type best suited to treat the entire supply.

The report also covers the design of an auxiliary pumping station needed to increase the capacity of the intake tunnel and so arranged as to be readily convertible into a low lift pumping station for a filtration plant, if such should be built.

Lessons from Experimental Operation—A miniature filter plant, with a capacity of 200,000 gals, per day, ws operated for one year from Oct. 1, 1917, to demonstrate the advantages of filtration and determine the best operating condition for Detroit's particular supply. Public sentiment was also developed and tested on the subject of filtration by piping the filtered water to the main entrance to Water Works Park and dispensing it freely from a booth, where hundred drank the water daily and many families secured water in bottles for domestic use.

Operations checked by an elaborate system of tests proved that the water of the Detroit river is capable of relatively rapid and inexpensive filtration and that the removal of bacteria under those conditions is adequate. The filtered water was of such clearness that a newspaper could be read easily through a volume of water several feet thick.

Recommended Plant—The filtration plant recommended in the report is of the rapid sand type and while, from the standpoint of capacity, it will be the largest similar plant in existence, there is plenty of room for its installation at Water Works Park without buying additional land and in this location it can be supplied with water from the present tunnel. It has a daily capacity of about 300,000,000 gals., suitable for 1930 or 1935 conditions; and is so arranged that it can be readily enlarged, if desired, to about 450,000,000 gals. daily capacity.

There is no better place for the water works intake than its present location. The proposed construction of an intake and aqueduct connecting with Lake Huron would cost several times as much as the filtration of the present supply, and the results would not be so good. The present water supply, when treated with chlorine, is relatively safe, but the taste resulting from the use of chlorine is objectionable and there are extended periods of turbidity when the appearance of the water renders it unattractive. Contamination of the Detroit River will increase with the increase of population on tributary water sheds. Filtration will put an end to the use of chlorine in unpleasant quantities, will safeguard the city against the certainty of increased pollution in the future. It will provide every consumer with water superlatively safe, clear as crystal and gratifying to the taste.

Estimated Cost of Filtration—The filtration plant described and recommended in the report is estimated to cost $5,800,000. The cost of filter operation, including low lift pumping, is estimated at $3.69 per 1,000,000 gals, while the interest and sinking fund charges would be $4.22, making a total of $7.91 per 1,000,000 gals., which, in spite of the present high prices, compares favorably with the costs in other cities. On the basis of the present rate policy, filtration would cost domestic consumers 6 cents per 1,000 cu. ft., or less than a cent a day per family.

Auxiliary Pumping Station Recommended—The large amount of water consumed on certain days during recent years has resulted in some difficulty, at such times, with the older high service pumps which are at too high an elevation to operate satisfactorily under low river conditions. It becomes necessary, therefore, either to undertake extensive improvements to the old pumping station

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or to construct an auxiliary low lift pumping station to raise water from the tunnel, at certain periods, to supply the high service pumps above referred to. As such auxiliary station, with very little change, can be made to serve as a low lift station for a future filtration plant, it seems logical to adopt this method of correcting present pumping difficulties.

Success of Filtration Demonstrated—The time is now long past when the basic principles of the filtration of municipal water supplies can be considered an experiment, although experimental plants so called, are useful in order to study the application of these principles to local problems. More than 750 municipal filtration plants are now in operation. In Detroit, particularly, has every speculative element been discounted. To a large volume of data from other localities has been added the fruit of a year's operation under conditions locally prevailing.

It is true, Detroit is not confronted with any severe sanitary crisis, but to progress only under the scourge of epidemics is not a desirable policy. This has been proved in many cases where cities have undertaken filtration projects without sufficient preliminary investigation and consequently at heavy cost. The logical process of improvement therefore and the one pursued in this instance, is to anticipate every possible source of disaster and to demand the best, rather than to be content with that which is passably good. For a moderate cost, Detroit can add to its industrial distinction and world-wide repute for civic enterprise the further priceless boon of an irreproachable water supply.

Progress Toward Construction—Since the submission of the report, the City Council has appropriated funds for constructing the low lift pumping station. This will probably be completed before the filtration plant can be built and will therefore be temporarily used as an auxiliary or Booster station to increase the capacity of the present tunnel. The low lift pumping machinery has already been purchased and bids are to be taken soon for the construction of the station proper.

Preparation of detail contract plans and specifications for the completed filtration plant have been started; and it is expected that contracts for at least a portion of the plant will be awarded wihin the next year if funds are available. The preparation of these detail plans is under the immediate direction of Major T. A. Leisen, Civil Engineer of the Detroit Board of Water Commissioners; and F. H. Stephenson, who was associated with R. Winthrop Pratt on the preliminary plans and investigations, is now acting as principal assistant to Major Leisen. Mr. Pratt has been retained by the Board to act in an advisory capacity.

Considerations Affecting the Choice of Pumps for Small Water Works

By Henry A. Symonds, Boston, Mass.

In designing a plant for pumping water for a small community, it is usually the case that the per capita cost of operating and maintenance is greater than in the large city plants, and it is important that a careful study be made of the relative merits of the different forms of power available, their adaptability, first cost, and efficiency when operating to do the particular work desired.

It is usually the case that strict economy must be practiced in the introduction of these works, and studies relative to first cost have usually been made to bring the cost of the work within the ability of the communities to pay. Not so much attention, however, has been paid to the question of relative efficiency and daily cost of operation, and it frequently occurs that plants are in operation which citizens of the town, and even the water works officials themselves, believe to be highly economical, and that are the reverse. The difference in cost of operation may be so great as to make it good business to pay a much higher price for an economical unit.

Water Power—The early use of power for pumping water in the small-town installations was largely by water power or steam, and it is possible that water power is coming back into use for pumping purposes, but probably through the medium of the hydro-electric plants, as it is not common to find good water privileges so located as to be directly available for pumping from the approved sources of water supply.

Steam Pumps—Steam has been used for many years very efficiently in many small plants.

Steam Turbines—The development of the centrifugal pump, which has now found so wide a field, was closely identified with the bringing out of the steam turbine.

The Ideal Small Pumping Plant

The centrifugal pump has been known for a great many years, but for a long time after it was invented the difficulty of getting suitable drive with sufficiently high speed retarded the development of successful operation of this type of pump. The real growth of this pump has occurred in the past ten years, during which time the use of the steam turbine and the electric motor with direct connection to the centrifugal pump has brought up the efficiency of the pump to a relatively high stage. At the present time the use of the steam turbine as applied to pumping water is mainly in the large units, and the motor is generally adopted for driving the smaller plants.

The result of the use of steam is, on the whole, satisfactory, but for the small water plants it is subject to the objections that the economical pumping machines with boilers are expensive and occupy much space, and provision for large storage of coal and adequate pumping-station buildings are required, all of which conditions add to the first cost of the plant and are aggravated by the fact that licensed engineers are required to operate such a station.

To-day we consider the ideal small pumping engine that which is economical in first cost and is self-contained, i. e., operates from a source of power which is part of the engine, or at least located in the same station. It is desirable to have it occupy as small space as is practicable, be simple in operation and not require the services of licensed men, easily repaired, quickly started, using fuel which is readily available at all times, and be capable of producing power at a relatively low unit cost.

Electric Motor

Many of the conditions of an ideal plant are met by the electric motor, and the electrical installation has become more and more common. The advantages are: Low first cost; it requires little space; low cost of maintenance; no expert supervision; it is especially well adapted to drive centrifugal pumps with direct connection, which saves friction loss of gears, and prevents noise; it may have automatic control; it may operate during periods of low load at central station, thereby getting lower rates; instant starting; as it has no reciprocating parts, it can be left to operate without attendance better than any other form of drive. The use of electricity has two serious defects in the average municipal plant, namely, it is not self-contained, but depends upon a line of wires and a power plant, usually at a distance, for its operation. For this reason neither one nor two units in a pumping station operated from the same plant are satisfactory to the insurance authorities, as they rightly claim that an accident to the wire line or the power plant will put both units out of use as quickly as one and leave the town or city in an unprotected condition in case of fire.

The advocates of the use of motors base their claims of low cost of operation upon the fact that attendance may be a minimum and that this is really the large item in operating small water plants. The writer believes that this argument has considerable merit, and that the improvement in efficiency

brought about recently in the centrifugal pumps, and the low cost of the pump and motor, with the advantages above referred to, make this form of pumping plant a very close competitor of, and in some cases it will be found actually to be a better business proposition than, the other types of pumps and engines, in spite of the difference in efficiency.

Gasoline Engine

Another form of drive which has been used in some of the small pumping plants is the gasoline engine. This form of power has practically all the advantages above mentioned except cost of operation, and in this it falls down badly, as it is operated upon a fuel of such high cost as to make the operation per horse-power-hour too high for practical purposes in the ordinary municipal water works. However, in plants where an emergency unit is wanted and electricity is not available or desirable for any reason, the gasoline engine may meet the requirements in a satisfactory manner.

Producer Gas

The gas producer as a source of power corresponds to the boiler in a steam plant. It has a great many advantages, and when combined with a proper engine for utilizing the gas to the best advantage may be considered as having most of the requirements of the ideal plant. This form of power has been used for some time, and, so far as the writer has record, with good satisfaction in all cases. Gas produced in this way may be used in various types of internal-combustion engines with slight modification. A plant of this kind can be installed at reasonable first cost, is self-contained in so far as the power is generated directly next to the engine itself, and operates at a remarkably low cost upon a relatively inexpensive form of coal. The plant takes up more room than some of the other types, and calls for a larger pumping-station space.

Fuel-Oil Engines

In the writer's experience, in nine cases out of ten, fuel-oil engines have proved an ideal installation for plants from 25 to 150 h. p., and for this reason it may be proper to give some extra details regarding this engine. The term "fuel-oil" is here used to mean any oil, from the heavier crude petroleum up to kerosene. Fuel-oil engines are today known under two general heads as Diesel and semi-Diesel, or surface ignition.

Semi-Diesel Engines

The idea conceived by Diesel is the bringing into compression a mixture of air and oil vapor to a point where heat is generated sufficient to ignite the combination. The compression reached varies from 500 to 1,100 lbs. per sq. in., but when the proper temperature occurs the gases burn rather than explode, and it is the claim of the producers of the Diesel type that this slower burning conserves the power of the gases, and the energy realized is utilized almost entirely in pushing the piston through the length of its stroke. In order to permit of the great pressure produced by this process, the machine must be exceedingly heavy, and the great amount of work which is required to perfect the Diesel engine makes it too expensive for the ordinary requirements of small water-supply plants.

The Semi-Diesel, or surface-ignition engine, on the other hand, gets its power by the explosion of a mixture of air and oil gas in the cylinder under compression around 200 to 300 lbs. per sq. in. While part of the energy is undoubtedly used in the shock against the metal of the plunger and cylinder, the resulting thrust produces motion of the piston, which is connected through the crosshead, or directly to a crank shaft which gives the motion to the driving pully or gear.

The Semi-Diesel seems to meet all the ordinary requirements of the ideal engine described above, and while the first cost of this engine is considerably greater than that of the gasoline engine or the electric motor, the operating costs are so low that this outweighs in most cases the advantages of the low first cost of the other machines.

Poor Fuel Oils Satisfactory

In the types which are considered as small pumping outfits, designed to pump water for communities of from 1,000 to 10,000 inhabitants, the engines required ranged from 25 to 150 h. p., but in the writer's opinion there is a large field for a still larger oil engine, and there are some machines now being produced that show wonderful efficiency in operation. They are of the Semi-Diesel type, but are able to operate on the poorest grade of fuel oil, and even tar products which have to be heated before it is possible to get them into the cylinders. The oil used runs as low as 18 degs. Beaume, while in the smaller machines—that is, below 60 h. p.—the writer knows of good results with oil heavier than 26 degs. Beaume, and with 25 to 35 h. p. engines kerosene or light oils of that grade have seemed to give the most satisfactory results. Pre-war prices ranged from 2 cts. to 7 cts. for the various grades.

The ordinary time of starting with fuel oil is from 12 to 18 minutes, but engines of this type may be equipped with apparatus which permits of instant starting by electric ignition and gasoline, the fuel oil being turned on after a few minutes, without interruption of the operation of the engine. This latter contrivance is of especial value where but little storage of water is possible and pumps have to be operated in case of fire, as the delay in heating the cylinder head may be serious if the supply of water is not available.

It is claimed by the advocates of the electric motor, in comparison, that the motor requires little attendance, while the oil engine calls for constant supervision. This claim is not entirely substantiated in practice, for many of the oil plants are operating for long periods of time without attendance. This of course assumes that there are duplicate units which will take care of any fire hazard if repairs are necessary. It should also be considered that constant attendance does not eliminate many of the breakdowns.

Perhaps the most satisfactory combination that can be installed for a small pumping plant for general municipal needs is made up of two duplicate units, of which it is probable that the fuel-oil engine meets the need fully as well as any other drive which has been developed up to this time.

One advantage, of considerable importance in some cases, that steam machines have over most of the other types is in the varying speed in operation. The speed in the electric motor and of the internal-combustion engines is variable only

TABLE 1—COMPARATIVE FUEL AND FIRST COSTS OF VARIOUS TYPES OF PUMPING PLANTS FOR SMALL WATER WORKS
1,500 g.p.m., 250-ft. total head; operating 300 days per year, nine hours per day; theoretical h.p., 94.7.

Pump.	Drive.	Pump Efficiency per cent.	H.p. required.	Cost of fuel per h.p. hour.	Total fuel cost per hour.	per 300 days.	Estimated cost of plant.	Remarks.
Vert. triplex	Fuel-oil engine	85	112	$0.004	$0.498	$1,209.60	$17,189	
Centrifugal	Fuel-oil engine	71	134	0.004	0.536	1,547.20	16,343	Guarantee—1 h.p. for 0.55 lb. fuel oil per hour. Price fuel oil, 4c per gal.
Vert. triplex	Steam turbine	85	112	0.0075	0.840	2,268.00	13,657	
Centrifugal	Steam turbine	71	134	0.0075	1.005	2,713.50	9,957	
Vert. triplex	Electric motor	76	125	0.0124	1.55	4,185.00	11,116	Coal at $6 per ton (2,000 lbs.)
Centrifugal	Electric motor	64	148	0.0124	1.84	4,968.00	6,248	Efficiency is combined pump and motor
Cross-compound, fly-wheel, steam pumping engine						1,350.00	17,000	Electricity cost, 0.9c per h.p.-hr. plus "service charge" of 77c per h.p., based upon max. h.p. in use, per month.
Compound-dup.-Deane steam pump (original plant). Rate about 700 g.p.m.						2,725.61		Actual figures of present cost. Rate of pumping about 700 g.p.m.

to a small extent, except by change of gears or belt pulleys, and it is sometimes necessary to pump to waste or through a bypass back into the suction, an uneconomical process, in order to keep the rate of delivery as desired.

Comparison of Costs

The writer had occasion, a short time ago, to make a comparison of different types of pumping plants, to determine which plant would best meet the needs of a community. In connection with this, the results of investigation of different units were tabulated and are given in Table I. The figures are not to be considered as exact, either of operation or first cost, but are obtained by using quotations and guaranteed efficiencies by the manufacturers of the different lines of machinery. These figures were also taken before the extreme rise of prices which occurred since the United States entered the war, and, while they are far above the averages of five years ago, it is probable that they are nearer what we may expect in the next few years than pre-war prices.

Acknowledgment

The foregoing article by Mr. Symonds is here reprinted from the Journal of the New England Water Works Association.

How to Reconstruct Small Water Power Plants

By Ray K. Holland, Consulting Engineer, Ann Arbor, Mich.

Developments that may be classed as small water power plants, with heads ranging from 8 to 20 ft., and with a contributary stream drainage area of 100 to 500 square miles, are principally for flour and feed mills, but there are a large number of small hydro-electric developments, both private and municipal, and water works pumping plants driven by hydraulic turbines.

The owner, in looking over a water power development that had been constructed prior to eight or ten years ago, generally feels, and correctly so, that the plant can be improved, but he is usually at a loss as to just how to go at it. He knows whether or not his present plant is sufficient in power to carry the usual load he imposes upon it, and he knows for what seasons of the year he is very short of water, and what seasons he has plenty of water, and approximately the range of head that prevails. He knows that the turbines are old and is aware that if he should purchase new wheels similar to those installed, he would undoubtedly receive more power; but when he makes an examination of the turbines, he finds that the replacement of perhaps a broken gate and a little lining up of the shafts will give him, in appearance, a turbine which looks as serviceable as a new one. The consequence of all this is that while he has a feeling that the plant ought to be reconstructed, he has not been satisfied that the reconstruction will show him a particular gain for his investment.

Engineer Must Study Conditions

If we, as engineers, could be called in to examine such a plant, with the idea of putting before the owner concretely what his needs are and what the costs will be, we find that we must start deeper in the problem if we will obtain for the owner any particular advantage in reconstruction. We must go back first to study his plant and check up as to whether the original installation was suited to the stream and the purposes to which he proposes using it.

The question of whether the machinery installed is suitable or not for the speed at which he desires to operate and for the prevailing head, we can pass up for the present, until study of the other considerations influencing the development is completed.

The stream flow is naturally of the most importance to the development, and its determination is usually our first consideration. The stream flow at a particular site may be determined by steam gagings or observations of flow over a dam of uniform crest and the like, but to be of any value the observation must extend over a considerable period of time. It is generally the case that there are no records of the particular stream at the particular site being considered. The engineer must then draw upon his accumulation of stream flow data of other streams, in the neighborhood if possible, having similar drainage basin characteristics, in order to estimate the probable flow of this particular stream at the site considered.

Application of Known Data

The judgment used in the selection of the records of known streams and their applicability to this drainage area is an all-important factor in this approximation of stream flow. It is to be particularly noted that three or four stream observations at this site, unless they be selected at extreme conditions and at average conditions, are of very little value in arriving at what might be the average flow of the stream in the course of a number of years.

Assuming that we have arrived now at the average flow of the stream, the next point to consider is the head under which the turbines will operate. The head, as we use it, is the distance from the average water surface level in the wheel pits to the average surface level of the water in the draft pit, or, in case a curved draft tube is used discharging the water down stream, to the water surface at the exit of this draft tube.

Factors Influencing Head

The two particular factors, therefore, influencing the head are the level of the water surface of the pond and of the tail race. The pond level is subject to variation due to the stream flow being less, or in excess of that used by the turbines. The excess is taken care of usually by flood gates or spillway, and the pond is generally at its highest level during such periods. When the river flow is less than the water used by the turbine, there is a draft on the pond and the water is pulled down.

The highest stage that the pond may be carried is generally controlled by the flowage rights and in each case requires investigation as to whether there are physical limitations to a higher pond stage—that is to say, whether the raising of the pond level will cause very large flat areas to be flowed, or is prevented by the physical conditions at the dam or plant. If no such limitations are present, it is usually advantageous to the owner to acquire flowage for a higher pond level, and it can be usually shown that this flowage is worth much more to the owner than he has assumed it to be, when he has considered it worth only the value of the adjacent property for farming purposes.

The tail water level is generally the level of the natural river before the development, and if there are no obstructions immediately below the plant, usually no particular advantage to the head may be gained by improvement to the tail race, such as deepening and the like.

Effect of Raising Pond

There is one factor usually present in the question of raising the pond that is little understood, and that is the question of backwater, meaning by backwater, the increase of the water stage due to the construction of the dam, over the water stage of the natural stream. With any dam constructed across a stream and with a normal stream flow and the pond level carried at the crest of the spillway, the maximum backwater effect will occur at a point located approximately at the intersection of planes tangent to the water surface of the pond and to the water surface of the stream above the pond. If the pond surface is now maintained at the crest of the dam, with increasing stream flow, the backwater effect will usually become less, and with decreasing flow becomes greater at this point, but if the spillway is of ample discharge capacity, so that the head on the spillway for the overflow increases at a lesser rate than the normal river stage for the same increased flow of water, the backwater effect at the point first considered becomes no greater with this increasing flow, when such increase of flow is wasted over the spillway.

While it may be found that the amount of the backwater effect is less with the increased flow being wasted over the spillway, at the same time it may be also found that the backwater effect reaches farther upstream. Usually this is of little importance because of the small amount of the increase of river stage, but should this back against another water power development, this small amount of backwater effect frequently causes a large amount of trouble.

The engineer should make a careful study and endeavor in such cases to present the problem clearly, so that it may be understood by the interested parties, and if possible form the basis of an agreement whereby the lower development may back water against the upper under the extreme conditions, thereby obtaining between the two plants the maximum power obtainable from the river.

Uses for Power

The use to which the power is to be put is our next consideration. If for milling or manufacturing, it is generally for 9 or 10 hours each working day, sometimes for the 24 hours. If for hydro-electric developments with a single plant, power may be required for 24 hours, but sometimes is required for only 10 or 12 hours, this usually where commercial lighting only is served, or for lighting and pumping where a reservoir or elevated tank is available.

In reconstruction, this matter is more or less definitely settled by the past performance at the plant, and the gain in power output from the higher efficiency usually provides a margin that insures the turbine being of sufficient capacity to care for peak periods.

Where a change in the length of period of operation or additional load is contemplated, particular attention must be given to the probable power obtainable at the site in order to advise whether the development will permit the change.

The capacity of the pond (in acre feet) is the factor which determines the ratio of the maximum power of the daily period to the average 24-hour power available from the river flow.

An acre foot being the quantity in an acre of water 1 ft. deep, the capacity of the pond is then dependent upon the product of the average area and depth of draft to which the pond may be drawn. The area being fixed by physical conditions, the capacity is directly dependent on the draft. But the draft on the pond reduces the head on the turbine and results in a power loss that increases at better than three halves power of the ratio of the change of head, consequently a minimum draft is desirable. From practical considerations 5 to 8 per cent of the head may be permitted as the draft on the pond.

Pulling Down the Pond

This question of pulling down the pond is one that the engineer should cover thoroughly with the owners of the development, as the usual rule is to find that the operators of the plant pull the head excessively at the beginning of the summer season and it is not given an opportunity to recover again until the fall rains, resulting in shortage of power during the whole summer. We find this condition usual with municipally operated plants and only little less frequent with privately owned plants. One plant, a year or so ago, whose average head is 15 ft., pulled the pond in the first three summer weeks to between 9 and 10 ft., and operated at these low heads all summer by generating some auxiliary power by steam and cutting short the street lighting period. The plant capacity at these lower heads for the same amount of water was less than one-half the capacity at the full head, and had the auxiliary power been supplied when the head started lowering, auxiliary power would probably only have been required the first week of the summer period. The best rule is perhaps to have the pond brought to normal stage at least once in 24 hours.

The ratio of the turbine capacity to the normal stream flow is determined as is shown above from the considerations of the load to be carried and the size of the pond, and the permissible draft on the pond.

Deciding Capacity of Turbine

We have now gotten the elements together that permit our decision as to the capacity of the turbines to be installed. By reference to our determination of the river flow we can select the point from the expected average annual stream flow that will give us the most economy in the relation of the cost to the power obtained. Naturally, if the installation is made equal to the minimum continuous flow, we would obtain the most power for the least money invested in machinery only, but because of the investment in the power house, dam, flowage rights, etc., we usually find that the economical development in most cases will occur at a point in the stream flow that may be said to be just above the average normal flow of the stream. Applying to the quantity of water flowing, we can obtain the theoretical 24-hour power of the development, to which must be then applied the factor previously determined by the use to which the power is to be put, resulting in the theoretical capacity to be installed.

If this be taken roughly at 70 to 75 per cent efficiency, the approximate plant capacity is obtained, which may be checked against the power required for the operations, and adjusted, if necessary, to meet the actual conditions that prevail. This adjustment, however, is usually at a sacrifice of the power that the stream produces. This is true from the fact that if a much larger installation is made, the efficiency of operation is less because of the necessity of running at small gate openings for longer periods, and if a much smaller turbine is installed, the possibility of not being able to carry the peak load becomes pertinent.

Selection of Turbine

As is generally known, a turbine of a given runner characteristic will have a practically fixed speed for a given head for each of the manufacturer's size of turbines, and it is necessary here to make adjustments and concessions between the capacity of the wheel or wheels and speed at which these wheels are to operate. The higher the speed, of course, the smaller the individual turbine. With hydro-electric developments this problem is usually complicated further by the fixed speed requirements of an alternating current generator, and with any development it is usually necessary that the speed selected be maintained constant, notwithstanding the variations of head that will occur.

It is therefore necessary that the engineer, in making the selection of the turbine, be conversant with the type characteristics and the standard capacities of the manufacturers' developed turbines and co-ordinate the number of turbines and the speed to the total capacity which is now practically fixed, to obtain the maximum power under the variations of head and load usually prevailing.

Aside from the runner characteristic of the turbine to be selected, some consideration must be given to the mechanical construction of the turbine, so far as relates to the shop work, strength and rigidity, these being more important where the turbine is to be operated on an extremely variable load, with the gates controlled by oil pressure governors.

Having selected the turbine, a computation of the probable annual output may be made, which, combined with the fixed and operating cost, forms a criterion from which the owner may arrive at a decision as to the necessity of reconstruction.

Details Affecting Operation

There are numerous minor details now to be considered relating principally to those affecting the operating of the plant.

If the power is to be used for milling and for general manufacturing purposes, the so-called friction governors are generally satisfactory, but if for hydro-electric work, it is usually necessary to have the more sensitive oil pressure governors. The question of bearings and the supporting of the runner and shaft is more important than the consideration usually given, because these points are the ones continually under the observation of the operator, and where no trouble is experienced he has faith in his machinery and does all in his power

to keep it in first-class condition, while, if he is continually having trouble with alignment of shafts and with bearings, he is very apt to become convinced that the entire equipment is no good, with the result that he does not give it the attention that it should have to deliver the power of which it is capable. This is a point that is frequently lost sight of, and is particularly important from the owner's point of view.

The structure to house the equipment is controlled primarily by space required for the machinery on the operating floor and by the requirement of ample water passages to and from the turbine, and secondarily, by the relation of the structure to existing structures, bridges, the channel, and the like.

The power-house construction itself does not differ materially from other first-class constructions except the requirement of water tightness, rigidity of construction and the necessity of providing that no settlement takes place. Special caution must be observed, however, that foundations are protected against undermining, as a small spurt of water at a critical point will very quickly wreck the best hydraulic structure.

The shape of the flume and location of the turbine in the flume requires special study, if for any reason that water area to the turbine is to be restricted. Trash racks and easily operated wheel pit gates are necessities to a well-designed plant, particularly the desirability of easy and quick operation of the head gates by the operator, as they serve as an inducement to him to the making of periodical inspections of the turbines and under-water mechanisms.

Unless the head is very low, the turbine is invariably placed above the tail water level, making the question of the draft tube a particularly important one, and not of easy solution, even when the engineer has wide latitude in his design. When space is restricted, the design of the draft tube must be governed largely by the designer's experience and the results obtained from other constructions where conditions analogous to those under consideration are present.

Examples of Plant Reconstruction

As a result of the practical application of the principle of making a study of the small plant reconstruction along lines very similar to those followed with a larger installation, I would cite the following reconstructions of this type made by our firm in the last couple of years:

In a hydro-electric plant in the northern part of Michigan, drainage area about 100 square miles, normal head about 14 ft., the old installation was a single turbine some 20 years old, rated at 170-h.p., apparently in good shape, except that the runner had the edges of the buckets bent by debris going through the gates. The turbine was gear-connected to a line-shaft some 15 ft. long, running at about twice the speed of the turbine, from which a 150-k.w. generator was belt-driven. The plant operated only on night load. This equipment was replaced by a single directly connected turbine and generator unit of 100-k.w. capacity, the rating of the turbine being slightly smaller than the orginal turbine and running at about 60 per cent greater speed. The plant is carrying from two to four times the load previously carried, and at no time within the last two years has the plant been short of water, as had been the case each midsummer and midwinter season previous.

A hydro-electric plant in the central part of Michigan, drainage area 500 square miles, 14 ft. head, formerly consisted of two turbines, each one gear-connected to two short horizontal lineshafts from each of which was driven a generator. There were two outgoing feeders from the plant and the load of both feeders was sometimes carried on the larger of the two generators, and at other times the units ran separately, one to each feeder. The reconstruction here was caused by the undermining of the foundation, resulting in a collapse of the power house. The equipment of the new power house was in two units, each consisting of a directly connected turbine and generator, the one unit being approximately one-half the capacity of the other, permitting power to be produced at high efficiency from about one-sixth to full capacity of the plant. The load on the plant has been approximately tripled since the old plant went out of service and no shortage of water has been experienced within the last two years of operation.

Increases in Power Output

A hydro-electric plant consisting of two turbines, gear-connected to a horizontal shaft about 20 ft. long, to the end of which was directly connected a horizontal shaft, slow-speed generator of 350-k.w. capacity, and to which was also belted a steam engine. One turbine, the gears and part of the horizontal shaft were removed, and a vertical shaft, directly connected generator unit installed, with a turbine capacity slightly larger than one of the original turbine. Upon completion of the work the load was thrown from the remaining gear-driven unit, to the new unit and 100 per cent additional load thrown on, and after shutting down the old unit the surface of the water in the tail race dropped about 4 ins., due to the decreased discharge through the new turbine, even when carrying double load of the old one.

In an industrial plant requiring power 9 hours, three old turbines were removed and replaced by one vertical shaft turbine, gear-connected to a mill, with the turbine selected for proper speed for connection to a future alternating current, vertical shaft generator. The new unit, although slightly larger than larger turbine of the old installation, is carrying, at about two-thirds capacity, the entire mill equipment, which has been materially increased over the installation which the old turbines could just carry.

Acknowledgment

The foregoing paper by Mr. Holland was presented before the Michigan Engineering Society.

Water Purification at Buffalo, N. Y.—Present and Prospective

By H. F. Wagner, Chemist, Bureau of Water, Department of Public Works, Buffalo, N. Y.

As to the purity of the Buffalo water supply, I think I am quite safe in saying that without any treatment at all it is as good as any that is available to cities having Lake Erie as their source of supply.

Sources

The greatest contamination occurs during the summer months and a large percentage is due to freight and passenger vessels which generally use the north channel entrance to Buffalo harbor, which course takes them within less than 1,000 ft. of the inlet crib and on the upper side. Upon the opening of the summer resorts a short distance above on the Canadian shores several excursion boats ply back and forth from Buffalo hourly. These boats carry thousands of people daily and with no restrictions or discrimination for the disposal of their sewage. This constitutes a great menace as excreta from this source may easily pass into the water supply and in a fresh and virulent state.

The shore drainage adding to the pollution, while considerable, is not necessarily excessive, as there are no cities of any size above us whose sewage might find its way into our water supply. There are several streams flowing into the lake within easy radius of Buffalo, but they are small and the tendency is for them to follow inshore, as the extensive use of floats has proven. In the winter, after navigation closes, and especially after the ice has formed, the water is of a most excellent quality. The bacteria count obtained on 37 degree agar is very low. There is one aspect, however, which has to be given weight and that is with reference to the condition arising as a result of the hundreds of fishermen who go out on the ice to fish. The excreta which these people leave upon the ice is a constant menace to the water supply, more so at thaw periods and acutely so when upon the coming of spring the ice breaks

Two 24-inch De Laval Centrifugal Pumps handling 30,000,000 gallons per day against 250 ft. head and driven by a three-phase slip-ring induction motor.

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A "WIRE TO WATER" efficiency of 82.5% is shown by two De Laval 24-inch pumps driven by a slip-ring induction motor in one of the pumping stations of the city of Minneapolis. The following figures relating to these pumps are from the official records of the city of Minneapolis.

Months	Gallons Pumped	Hours Run	Total Head	Efficiency
1918				
June	931,900,000	689.5	248.74	80.9
July	926,850,000	688.0	250.49	81.5
August	938,650,000	696.0	249.64	81.3
September	842,150,000	623.0	249.91	81.6
October	789,650,000	584.5	251.11	81.7
November	579,350,000	431.5	253.46	82.1
December	789,850,000	603.5	259.66	83.2
1919				
January	801,350,000	608.5	259.38	83.6
February	763,600,000	592.5	261.89	83.3
March	94,900,000	74.5	266.62	84.0
April	934,000,000	679.0	248.67	82.8
May	968,400,000	724.0	251.37	82.4
Totals	9,360,650,000	6,994.5	3,050.94	988.4
Monthly average (year ending May 31st, 1919)	780,054,166.67	582.875	254.245	82.36 2/3
June 1919				
	942,950,000	700.0	251.09	82.5

Each De Laval centrifugal pump is guaranteed as to capacity and efficiency and is fully tested before shipment. We would take pleasure in estimating upon pumps to meet your requirements. Now that our government contracts are practically completed we are able to make prompt shipments.

DE LAVAL STEAM TURBINE CO.

515 JOHNSON AVENUE, TRENTON, N. J.

88

up and all is carried in the direction of the crib. It can be seen, therefore, how most of the contamination occurs at uncertain periods. This condition makes it necessary that chlorine be added to the water in sufficient quantities to take care of the high wave at all times even though the dose may be in excess of that actually essential 75 percent of the time.

Chlorination

Our chlorination apparatus is located at the Intake Pier, where the chlorine solution is injected into the mouth of the 12-ft. arched tunnel. This, therefore, affords a run of over a mile in a leak-proof tunnel and gives ideal conditions for sterilization. We are using a chlorinating apparatus, formerly manufactured by the Electro Bleaching Gas Co., and it is the float meter type. The float in this apparatus is about 3 ins. long and has never caused us any trouble from sticking as has been the case where the small indicator was used. Our chief trouble with this apparatus has been caused by the clogging up of the pressure reducers, which requires taking apart every once in a while for cleaning. Generally, it is necessary to replace the old diaphragms with new ones when this is done.

The amount of chlorine used ranges from an average of 0.16 parts per million to an average of 0.28 parts per million. These figures are equivalent to about 1 lb. and 2½ lbs. per 1,000,000 gals.

Standard of Purity

I do not believe in any set and fixed standard for a safe water. In other words, the same standard is not applicable to any two waters and when such is aimed at there is certain to be a variation of one from the other in actual practice. A set standard will be hard to abide by because of the great difference in the kind and character of the pollution, or, while the standard may be too severe in some cases it is not severe enough in others, and therefore misleading. A standard is no sooner proposed for certain conditions than it is at once grasped and applied to a great variety of conditions. Our standard and procedure is that the bacteria count made on 20° agar is a gage of the efficiency of the sterilization plant and means nothing as to whether the water is safe or not. The real knowledge is obtained from the test for organisms of the bacillus group. Of the different kinds of media in use, I do not believe we are far enough advanced to say standard media, I prefer Lactose Peptone Bile. Our own standards are that we aim to eliminate gas formers to the extent that negative tests are obtained on 4 out of 5 in 5 c.c. samples of the treated water.

Prospective Filtration

Physically, the condition of the water is open to severe criticism from 10 to 15 percent of the time. This brings us to the subject of filtration. Lake Erie lies to the west by southwest from Buffalo. It is from this direction that come the winds which render our water supply turbid and when we are told that we need a filter plant. These winds prevail principally during the fall months when our highest turbidity occurs. Compared to some waters, this is not at all bad, as 250 parts in a million is about the maximum. It consists principally of very finely divided clay, the percentage of organic matter being very small. Generally, the sediment is offensive for from 3 to 6 days at a time, for the sediment is quite heavy and settles rapidly as soon as the disturbing element is removed and the second day after a blow the water has improved 50 percent. In all the water is noticeably turbid from 30 to 60 days of the year.

In planning for a filtration plant in Buffalo, consideration must be given to the following points: First, do the prevailing conditions of the water as herewith set forth warrant such an expenditure? Second, the water consumption must be reduced to a reasonable figure and waste reduced to a minimum before such a project is feasible. And lastly, and perhaps the most difficult problem, is a suitable location for a filter plant. When the water works were originally laid out, it seems, the idea that Buffalo might some day have such a plant was not thought of, or at least no provision was made for its possible location. As to the proposition that the water be pumped to an elevation outside of the city and returned by gravity I would explain this by saying we are here handicapped by the flat nature of the country around us. To secure an elevation anywhere near sufficient for the purpose it would be necessary to go out at least 15 miles into the country. The enormous expense that would be incurred in securing the right of way and in constructing a dual pipe line of the size which would be sufficient for the purpose would place too heavy a burden upon the resources of the city of Buffalo.

I believe, however, that a solution to this problem will eventually be found as I have here very briefly outlined. Directly to the south of the Porter Avenue Pumping Station, the grounds being separated by Jersey Street only, is a large tract of water front land which is at present used for a dumping grounds. Part of these lands are covered by the harbor waters but can be easily reclaimed by a retaining wall and subsequent filling in. I believe that this would make the best location and in fact all that could be desired for a rapid sand filtration plant. The water could be diverted to the filters by short extensions to the existing canals and raised to the required height by low duty pumps. After passing through the filters the water would be permitted to return to the original suction wells by gravity and distributed through the present system.

Acknowledgment

The foregoing matter is from a paper by Mr. Wagner presented before the recent annual convention of the American Water Works Association.

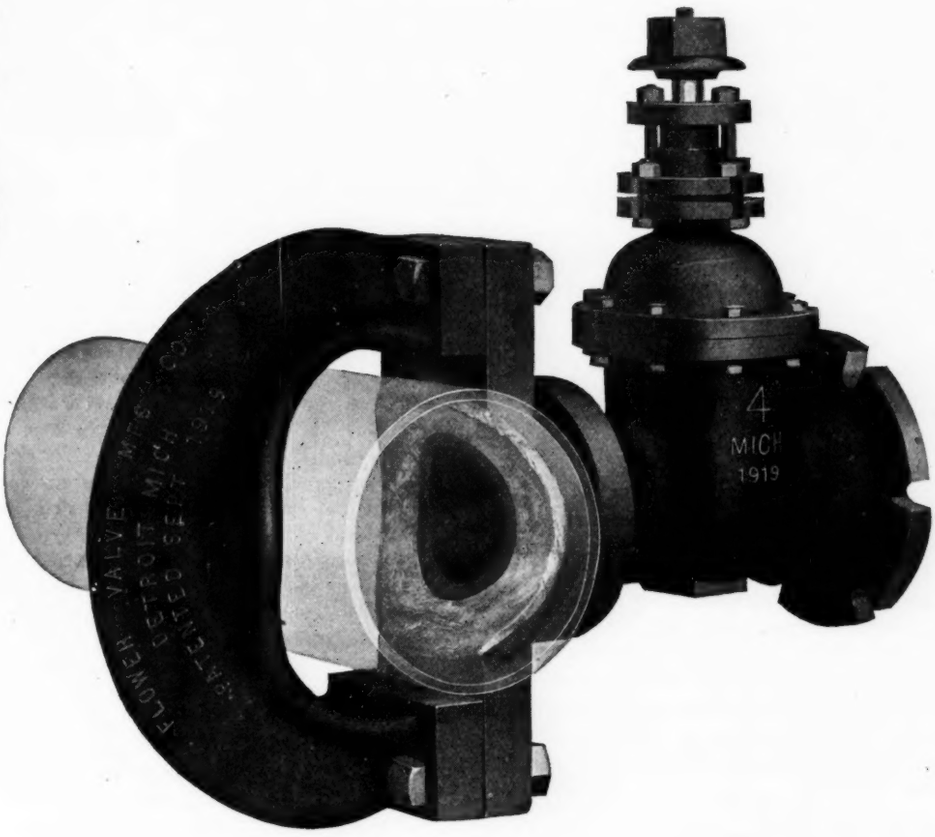
Cost Data on Small Water Works Systems

By William Artingstall, Consulting Engineer, Old Colony Bldg., Chicago, Ill.

The expenditure incurred for water supply for small cities is dependent on the locality and varies in the per capita cost due to the local conditions peculiar to each city. This variation is due not so much to the cost of the water mains and feeders as it is to the cost of the pumping plant and the difficulty (or ease) with which the necessary amount and kind of water is obtained. For this reason it is customary to let separate contracts covering these two phases of the work and in the majority of cases the cost of the supply is not reported for public information. In Table I, the cost of the distribution system is all that is given unless otherwise noted. To this cost must be added an amount per capita of from $15 as a minimum to $40 or $50 as a maximum. In cities where there are no deep wells nor expensive pumps to install, the cost would run in the neighborhood of $15 or $20. Table I, will

TABLE I—EXPENDITURES FOR WATER SUPPLY SYSTEMS IN SMALL CITIES AND VILLAGES IN 1919

Town	State	Population	Expenditure Total	Per Capita	Remarks
Oneida, S. D.		150	$30,000	$200.00	Incl. Plant etc.
Dumont, Minn.		188	Contract not yet awarded		
St. Clair Beach, Mich.		200	approx. 10,000	50.00	Approximately
Ladora, Iowa		260	17,790	58.50	
Waconda, S. D.		326	30,000	92.50	Complete
Garber, Okla.		382	22,500	59.00	
Pretty Prairie, Kans.		327	32,000	97.50	Complete
Menno, S. D.		621	35,000	56.30	
Foley, Minn.		710	40,000	56.30	
Hettinger, N. D.		766	27,000	35.00	
Dexter, Ia.		767	36,000	47.00	
Townsend, Mont.		759	30,000	39.60	
Wendell, N. C.		759	36,000	47.30	
Orem, Utah		800	100,000	125.00	Complete
Markesan, Wis.		892	55,000	61.50	
Walker, Minn.		917	25,558	27.80	
Fairmount, Neb.		921	35,000	37.00	
Grand Junc. Ia.		1,012	40,000	40.00	
Ferndale, Mich.		1,070	85,595	79.00	Complete
Spearfish, S. D.		1,130	49,800	44.00	
Spirit Lk., Ia.		1,162	52,763	45.50	
Roundup, Mont.		1,513	38,000	25.70	Approximately
Aiken, Neb.		1,638	40,000	24.00	
What Cheer, Ia.		1,720	50,000	29.00	



A Revolutionary Improvement in Sleeve Construction

THE new Flower sleeve (patented September, 1918) is unquestionably the greatest time and labor-saving improvement made since the first sleeves were built.

It comes to you ready for installation with the lead in place. The lead is firmly imbedded in dovetail joints in the sleeve and shaped to the contour of the pipe, which eliminates the difficulties of pouring in the trench. This permits making a smaller trench and setting the sleeve without the necessity of pouring lead for the joints.

The Flower sleeve simply needs to be bolted firmly in place, the tapping machine placed on the hub of the tapping valve, and the tap made in the usual way, with any standard tapping machine on the market. Little or no caulking is required in making the joint between the pipe and the sleeve proper.

The sleeves are all cored for class "B" pipe. The bolts used are "Sherardized," preventing rust, and are of ample size and length to permit the use of class "C" pipe or even larger. If caulking is necessary, the area is so small and the caulking joint so easily accessible and in full view, that it is easily done without special tools.

We want you to have full information regarding this improved sleeve, as it will facilitate your work and save you time and money. The old style sleeve requires so much lead in the larger sizes that the cost is materially increased.

Write us for price list and full description

The Flower Valve Manufacturing Company

117 Parkinson Street **DETROIT, MICHIGAN**

(19)

TABLE II—APPROXIMATE COST OF HOUSEHOLD PLUMBING FIXTURES

	*Class 'A'	*Class 'B'
Laundry Tubs	$12.00	$ 6.00
Kitchen Sinks	12.00	6.50
Bath Tubs	32.00	18.00
Toilets	22.00	12.00
Wash Bowls	7.00	4.00
Hot-water Tanks for Kitchen & Bath Supply	9.00	7.00

* Class 'A' is a moderate priced article.
Class 'B' is a cheap article.

show approximately what has been expended in some of the smaller cities during the past year.

Note that as the size of the city increases, the cost per capita becomes less due to a greater density of population.

Table II gives the present, approximate, cost of plumbing fixtures. These data are given as local authorities usually anticipate that sewerage systems will quickly follow water systems, and in deciding on the installation of a water system the individual householder can see what the prospective cost for the house end of a sewerage system will be.

Recent Water Works Improvements at Lansing, Mich.

To the Editor:

In 1918 we completed the building of two 3½ million gallon reinforced concrete, circular, underground reservoirs. We also completed the construction of a new pumping station containing the following equipment: One 10-million gallon, high duty Snow pumping engine, one 5-million gallon Holly pumping engine, steam driven, one 4-million gallon, two stage centrifugal, motor driven Alberger pump and one 750-h.p. Stirling boiler equipped with Taylor Stokers.

We have added to our water supply which is from deep wells, three 20-in.x400-ft. wells in Marshall sandstone, equipped with 4-stage American Well Works turbine type of pump, located 130 ft. in the well and operated by 50-h.p., 2,300 volt A. C. motors which deliver their water to the reservoirs.

At the present time we have four sub pumping stations with the pumps located at the surface, pumping gangs of wells. These sub stations furnish us approximately 6,000,000 gals. of water per day. Our new 20-in. wells produce approximately 1,000,000 gals. of water per day per well.

We have something over 10,000 services which are all metered.

Very truly yours,

Guy G. Crane, Manager.

Lansing, Mich., Sept. 19, 1919, Board of Water and Electric Light Commissioners.

Ozone as a Disinfectant in Water Purification

By Joseph W. Ellms, Consulting Sanitary Engineer, Engineer Of Water Purification, Division Ave. and W. 32nd St., Cleveland, Ohio

Ozone was first observed by the Dutch chemist Van Marum in 1785, while operating a static electrical machine. In 1840 Schoenbein, while investigating the properties of the gases produced in electrolizing water and electrifying air, noted the odor and oxidizing properties of the gas and gave it the name of "ozone", because of its peculiar odor. It was not until the results of Soret's work in 1865 were known that scientists agreed that ozone was tri-atomic oxygen, although it had been generally held that it was some form of oxygen.

Ozone is an unstable gas requiring a large amount of energy for its formation (34,000 calories). It is but slightly soluble in water, and undergoes decomposition when heated. When strongly ozonized oxygen is liquefied and the product subjected to fractional distillation, a mixture of ozone and oxygen results, of which about 85% is ozone. The factors governing the "ozone-oxygen system", are none too well understood. The state of equilibrium which exists in a mixture of the two gases is dependent upon several factors, such as temperature, pressure, and electrical conditions that are extremely complex.

Ozone is an extremely energetic oxidizing agent. It attacks many inorganic oxidizable substances readily, and is particularly destructive of organic matter even at low temperatures. Its value as a bactericidal agent is probably due to this property, and is the reason for its use in the disinfection of drinking water.

For practical purposes, the production of ozone can best be effected by certain forms of electrical discharges through oxygen gas, or through air, which, of course, consists in part of oxygen. It may be well to describe the nature of these discharges so that the technical difficulties of the practical production of ozone will be better appreciated.

Production of Ozone

The phenomena of an electrical discharge through a gas is complicated. Ordinarily gases are non-conductors, but may become conductors under certain physical and electrical conditions brought about by the flow of the current through them. When two electrodes are separated by a gas, and connected to some source of high tension electricity, and between which the potential difference is being gradually increased, there is first produced an invisible electrical discharge which gradually becomes visible by a glow upon one of the electrodes. As the potential difference increases the corona effect is produced, which changes to the true brush discharge. It is this latter form of discharge that is regarded as the most effective in the production of ozone. By still further increasing the potential difference between the electrodes there is formed in succession the spark discharge, the flame discharge and finally the well known electric arc is established.

The brush discharge is of a dark blue violet color and is accompanied by a peculiar hissing sound and the "electric wind," which latter, according to J. J. Thompson, is due to a current of electrified ions that set the air in the vicinity of the discharge in motion. Brush discharges are readily formed on electrodes having sharp points or roughened edges. Alternating or direct current may be used, but usually the alternating current is preferable since it may be obtained more readily under high tension. A better production of ozone appears to be obtained with alternating currents of high frequency. A 500 cycle alternating current is more commonly used in ozone installations than one with lower frequencies.

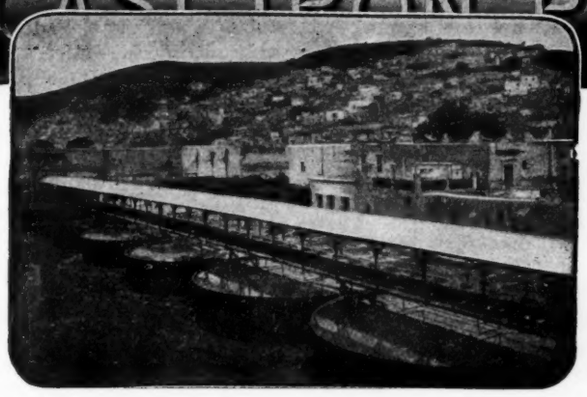
It has been found, as a result of much experimentation, that the use of a dielectric between the electrodes increases the yield of ozone, in other words, imposing even greater resistance than that offered by the air itself, effects a larger production of ozone by the discharge. Dielectrics are made from various substances, such as glass, mica, fused quartz and "Bakelite". While many other substances will act as dielectrics, the above named include the practical materials available in ozone work.

It will probably be appreciated from the little that has been cited of the complex character of the phenomena of ozone production, that the pressure, temperature and humidity of the air being electrified, the form, size, spacing and material of the electrodes, the kind of current employed, the frequency in the case of an alternating current, the voltage, amperage and other secondary influences of an electrical nature in general, and the kind and arrangement of the dielectrics employed, are factors that must all be given careful consideration in an efficient ozone apparatus. A brief description of one or two of the ozonizers that have been developed and have been used may be of interest.

Two Types of Ozone Apparatus

There are two general types of ozone apparatus. The Siemens-Halske ozonizers are of the vacuum tube type, in which air is drawn through an annular space across which high-tension electrical discharges occur. An inside metallic

A "Daring Experiment"



in "Mexico's Treasure-House"

GUANAJUATO REDUCTION AND MINES COMPANY
Sand leaching tanks, with slime tanks in background, showing sands under treatment

"The position of the Bustos mill site, in a narrow valley with little flow of water to carry off the residues, made necessary a somewhat daring experiment, that of separating the crushing and concentrating portion of the plant by a distance of nearly a mile from the cyanide plant, which could be located on the main stream of the district where there is always sufficient water to carry away residue or tailings discharged. Against practically the unanimous opinion of all visiting engineers who were consulted, it was decided to carry the ores, after they had been crushed and concentrated, through a small cast-iron pipe, laid with uniform grade, from the Bustos mill to the cyanide plant situated in the heart of the city, utilizing simply the flow of the water in which the ore was crushed, due to the gravitation of the pipe. As the grade available was only 2¼% it was believed by almost every one that the sand could not be carried, and that the pipe would inevitably be choked and stopped up. Certain experiments were made upon this matter which caused the company to proceed with their construction on the original lines indicated.

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MORE THAN 250 YEARS OLD

"The plants were started March 1, 1906, and have been in constant operation, 24 hours a day since that time. The pipe line, which was looked upon with so much fear by visitors, demonstrated at once that not only was there no danger of stoppage but that it would actually carry several times the volume of pulp treated with perfect ease, and with much less water than is normally used in the mere crushing and concentrating of ores. In fact, before the normal stamp-mill pulp, coming from the concentrators, is introduced into such pipe line, the company, by means of large settling cones, are removing something like 50% of the water and returning it immediately for mill use, the pulp flowing through a mile of 8-inch cast-iron pipe without experiencing the slightest difficulty, thus effecting the transportation of 250 tons of ore per day, for the distance of a mile through the heart of a crowded city, and this without a cent of expense. The pipe being, in general, buried throughout a considerable distance of its length, requires no expensive maintenance or inspection, and the right of way for such a line was, naturally, but a small fraction of what would have been necessary for any other means of transportation possible." (From "Mexico's Treasure-House", by Percy F. Martin, F. R. G. S., pages 93-94.)

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cylinder acts as one electrode. It is covered by a slightly larger tube of glass covered with tin foil. The electrodes are water cooled. The General Electric and the Gerard apparatus are of the tube type also. The Small-Linder, Abraham-Marmier and Vosmaer apparatus use plate forms of electrodes and dielectrics. In some cases their electrodes are hollow and water cooled, but in others this cooling is not attempted. Voltages varying from 2,000 or 3,000 to 55,000 or 60,000 have been used in various ozonizers, but from 10,000 to 20,000 volts are more commonly employed. The yield of ozone increases with an increase in wattage for any given area of electrodes, that is with the density of the current per unit of area.

Application to Water

The application of the ozonized air to water, where the ozone is to act as a disinfecting agent, has been given considerable attention by investigators, but much more study of the problem is needed. In some cases the flowing water is used to suck the ozonized air through the ozone generator and into the water to be treated. This method is not susceptible of very close control. Another method consists in pumping the ozonized air into the bottom of towers down through which the water descends. A modification of this latter method consists in placing the air compressor back of the ozonizer, thereby avoiding handling the corrosive gas in the compressor. In this case the ozonizer must be in a container that will withstand the air pressure required to overcome the hydrostatic head of the water columns and the friction head resulting from the flow of the air through pipes and towers. A third but expensive method has been used in which the water has been sprayed into the atmosphere of ozonized air. Baffled towers where the counter-current system is used have not proven very successful.

A great deal is yet to be learned regarding the proper method of distributing the ozonized air at the bottom of the column of water, so that a maximum absorption of ozone may be effected.

Since the expenditure of so much electrical energy in ozonizing the air creates more or less heat, and in consequence subsequent decomposition of the ozone formed, cooling and drying the air by refrigeration have been usually resorted to.

In small plants, passing the air over chemicals that would absorb the moisture, has also been successfully utilized. The yield of ozone apparatus naturally varies greatly, depending upon the manner in which the air is handled both before, during and after the passage of the gas through the ozonizer. Mr. Russell Spaulding in a report to the New York State Department of Health in 1913, very concisely states the desirable features of a good ozonizing apparatus. He estimates the theoretical yield of ozone for an expenditure of one kilowatt of electrical energy to be 1,386 grams. Since the actual yields of apparatus will vary all the way from 10 to 60 grams per kilowatt, it is evident that their efficiencies are very low. Mr. Spaulding summarizes his conclusions as follows:

"To summarize them, the main desiderata in generating ozone are:

1. A supply of alternating electric current at low cost.
2. An efficient transformer to obtain high tension.
3. Ozone electrodes that do not generate heat to
   a. Disrupt the dielectrics.
   b. Cause reversion of ozone to oxygen.
   c. Require external means of cooling.
4. Ozone electrodes that will approach the theoretical efficiency much more closely than the various systems now in use."

To this the writer would add, that unless the ozonized air is effectively applied to the water to be disinfected, that is, unless practically one hundred per cent absorption of the ozone by the water is effected the over-all efficiency of the entire apparatus may still be far from satisfactory. This phase of the subject still warrants considerable investigation.

The ability of ozone to reduce the bacterial content of a water has been too frequently demonstrated to doubt its inherent disinfecting properties. Nevertheless, it has its limitations in this direction like other disinfectants. In waters containing too large an amount of organic matter some of the bacteria may escape being killed. Pathogenic organisms probably are more readily killed than the ordinary water forms, because of the unfavorable conditions imposed upon them in the water, as well as from the destructive effect of the disinfectant. Spore forming bacteria may also escape destruction. Ozone, because of its strong oxidizing powers, has the merit of being able to oxidize and remove tastes and odors due to organic matter in suspension or solution, and to reduce the color due to vegetable stain. If ferrous iron exists in a water, it is able to oxidize the iron to the ferric condition, in which form it is practically insoluble, and hence may be removed by sedimentation and filtration.

In conclusion, it may be well to point out that ozone used as a disinfecting agent is no more a cure-all for a polluted water supply than are other disinfecting agents that are at present more widely employed. As a supplement to filtration processes ozone can be used with good effect, and thereby render the water safer for drinking purposes. That the process needs investigation and scientific development in order to make it economical and efficient, cannot be denied by its most ardent advocates. When such a development is brought about, its use in the purification of water will become more general and its points of real merit better appreciated.

Acknowledgment

The foregoing paper by Mr. Ellms was presented at the recent annual convention of the Central States Section of the American Water Works Association at Erie, Pa.

How to Finance Public Improvements in Illinois Villages

By William Artingstall, Consulting Engineer, Old Colony Bldg., Chicago, Illinois

[When it is suggested to a Village Board that they install a public water supply, or other public improvement, they invariably ask two questions: "What will it cost?" and, "Where will we get the money?" The first question can be answered only after making the necessary preliminary plans, cost estimates, etc. The present article is an answer to the second question for Illinois conditions. The Local Improvement Act in this state is such a formidable statute that it frightens progressive tendencies out of many honest heads. Originally drawn to safeguard the public, it is so precise as to detail and is so technically interpreted by courts that it makes it impossible for well-meaning people to progress without competent advice at every step. The present article clears up the points that are usually most bothersome to city officials and others, including engineers.—Editor.]

Four Methods of Raising Money

The four methods of raising money with the least hardship to the public are:

(a) Bonds may be issued to cover the cost of the work and the ordinary procedure followed to provide for a sinking fund for the retirement of the bonds as they come due. Bonds may be issued for periods of from one to twenty years and bear interest at not to exceed five per cent. per annum. The form is established by the statutes.

(b) Payment may be made out of the corporate funds raised by general taxation or out of an income, if the city is fortunate enough to have such source of revenue. In this case the five per cent. limitation applies.

(c) Payment may be made by levying a "Special Tax." This may be spread so as to cover the whole city or it may be limited to a certain district in which the proposed

improvement is to be constructed. The tax must be an equal one and is spread regardless of whether one piece of property is benefited to a greater or to a less degree than some other piece. This method is not very satisfactory except in connection with some general improvement or in connection with a special assessment where the whole town is benefited, but not to the same extent as the district in which the improvement is located, and for which a special assessment is also levied. For instance, a park might be created, the cost of which would be met by a special tax; but the cost of the pavement on a particular street leading to this park would be met by a special assessment to cover the particular benefits which the property would enjoy over and above that enjoyed by the creation of the park.

This is a very common method of raising money to pay for much needed improvements and is equitable in that whatever tends to improve a neighborhood, or section of a city, also tends to improve the city as a whole.

(d) Payment may be made by what is known as "Local Assessments" the details of which will be taken up somewhat extensively in the following pages.

Special Assessment for Local Improvements

Where there are objections to constructing certain improvements either under a bond issue or by taxation, an opportunity is presented to take advantage of a different method of financing and prosecute the work under what is known as "The Local Improvement Act." Operating under this act, the cost of the improvement is assessed not against the whole municipality, but against only the property benefited, and the amount assessed against any particular piece of property must be only in proportion to the benefit the tract derives from the improvement. Furthermore, the determination of the benefits and assessments are in each case subject to review by the courts, which, if need be, revises the assessment.

In view of the many desirable features of this law, particularly the assessing of cost against only those benefited and in the proportion benefited, the municipality can consummate many improvements that would otherwise be postponed or abandoned entirely.

The Local Improvement Law is easily understood by the average citizen, but it is strictly interpreted by the courts, which insist on absolute compliance with the same and the uniformity of precedents which have been established.

Statutory Authority

The Constitution of the State of Illinois provides that—

"The General Assembly may vest the corporate authorities of cities, villages, and incorporated towns with the power to make local improvements by special assessments, * * * etc." and the statutes of the state provide that—

"The corporate authorities of cities, villages and incorporated towns are hereby vested with the power to make such local improvements as are authorized by law by special assessment or by special taxation of contiguous property or otherwise as they shall by ordinance prescribe."

The Supreme Court has held that the city or incorporated town or village may by ordinance adopt the provisions of the "Local Improvement Act" and where so adopted, they shall have the right to take all proceedings therein provided for and enjoy the benefits of all the provisions thereof.

The corporate authorities are clothed with the power to determine whether or not a local improvement is required and also its nature, character and location, when it shall be made, and the manner in which it shall be constructed and the courts have no power to interfere to prevent the construction on the grounds that its construction is not necessary or that

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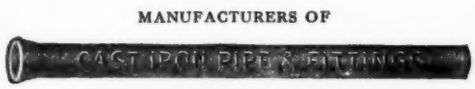

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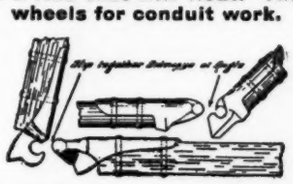

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THEREFORE NO DUTY FOR PURCHASER TO PAY
PACIFIC COAST DELIVERIES MADE FROM SAN FRANCISCO.

the cost is an unreasonable burden on the property sought to be assessed.

(Sect. 8 L. I. Act Hurd's Rev. Stat. 1905).

(C. & A. RR. vs. City of Pontiac 169 Ill. 155).

(Clark vs. City of Chicago 214 Ill. 318).

The method of making the improvement, i. e., by special assessment, special taxation, by general taxation, or by a combination of one of the first two with the latter, rests with the discretion of the local authorities and their exercise of such discretion is not subject to judicial control. (Washburn vs. City of Chicago 198 Ill. 506. Walker vs. City of Chicago 202 Ill. 531. City of Chicago vs. Haywood 176 Ill. 130).

It is necessary however that "No ordinance for a local improvement to be paid for wholly, or in part, by special assessment or by special taxation shall be considered or passed by the City Council or Board of Trustees of any city, village or incorporated town, unless the same has been first recommended by the Board of Local Improvements, provided for in this Act." (L. I. Act Hurd's Rev. Stat. 1905.) Under this section it is evident that the ordinance must be first recommended by the Board of Local Improvements created for the purpose of determining the preliminary questions relating to the proposed improvement (or improvements) which when determined act as a restriction on the power over the property of the citizens, which power the corporate authorities possess. If the Board has competently performed its duties, it is fully informed as to the necessity for the work, the cost, and the views of the citizens or owners of the property to be assessed to pay for it, before a report and recommendation is made to the Corporate Authorities of the municipality. (Givens vs. City of Chicago 188 Ill. 348.

The Board of Local Improvements is assumed to have at heart the welfare of the community and to this end has full power to originate an improvement whether it is in harmony with the majority of property owners or not and even if it be in opposition to the sentiment of the public. (L. I. Act Sec. 6). However, a majority of the abutting property owners have the right to petition the Board to make an improvement and in that case the Board must take the necessary steps forthwith. The nature and cost of the work are matters that still lie in the discretion of the Board at the close of the public hearing. (L. I. Act Sec. 24).

The power conferred upon municipalities to levy local assessments is restricted to the real estate benefited, in the municipality. When the assessment is in the form of special taxes, the levy is confined to the contiguous property, and where it is by special assessment the levy is limited to only the property benefited by the proposed improvement. (Guild vs. City of Chicago 82 Ill. 472).

A special assessment is a charge against the property and not against the owner (Demster vs. People 158 Ill. 36) and in case of a sale of the land, the amount of assessment rests against the property and not against the previous owner. Payment of the assessment, of course, discharges the indebtedness.

Board of Local Improvements

The Local Improvement Act provides that "in cities of less than 50,000 inhabitants, the Board of Local Improvements shall consist of the mayor, or president of the village board, who shall be president of such Board of Local Improvements, the public engineer and superintendent of streets, where such officers are provided for by ordinance; but if no such officers shall be provided for, then the city council or board of trustees, as the case may be, shall by ordinance designate two or more members of such body, who with the mayor or president of such village or town, until otherwise provided for by ordinance, constitute the members of the Board of Local Improvements." (L. I. Act 406 Hurd's Stat. 1905).

Preliminary Proceedings to Making a Local Improvement

Section five of the act forbids the corporate authorities not only from passing but also prohibts them from considering an ordinance for a local improvement payable by special assessment, or by special assessment and special taxation of contiguous property, unless the same is first recommended by the Board of Local Improvements; and further, the ordinance must originate with the board. The reason for this is that without having obtained the necessary information, which as will be seen later, it is the duty of the board to obtain, before any recommendation is made in an ordinance to be adopted by the village board, no intelligent action could be taken by the latter in regard to an ordinance for such improvement.

A majority of the property affected (i. e., the owners of a majority of the frontage) may petition the board for a local improvement. This petition should be addressed to the Board of Local Improvements, which is vested not only with the power of carrying out the will of the property owners but also vested with the power of originating a scheme for an improvement on its own initiative to be paid for by special assessment or by special taxation. The board is required to adopt a resolution describing the proposed improvement and transcribe the same in its records at once, whether the act was presented by a petition of the property owners or originated with the board. Said resolution shall describe the proposed improvement, describe the property to be taken, if any (or any that may be damaged) and shall fix an hour and day not less than ten days from the adoption of the resolution, for the public consideration of said resolution and shall make a part of the resolution an itemized estimate of the cost of such improvement as made by the engineer for said board. (Bickerdike vs. City of Chicago 203 Ill. 636. L. I. Act Sec. 7 406), but such resolution need not state how the improvement is to be paid for nor need it include the signature of the engineer nor any general remarks. (Zeigler vs. City of Chicago 213 Ill. 61). "Notice of the time and place of such public consideration or hearing shall be sent by mail directed to the person who last paid the taxes for the preceding year on each lot, block, tract or parcel of land fronting on the proposed improvement, not less than five days prior to the time set for such public hearing. Said notice shall contain the substance of the resolution adopted and a notification that the extent, nature, kind, character and estimated cost, may be changed by said Board at the public consideration thereof and that if upon such hearing, the Board shall deem such improvement desirable, it shall adopt a resolution therefor and prepare and submit an ordinance as hereinafter provided." (Sec. 7 L. I. Act). At the time and place fixed for the public hearing, the Board shall meet and hear the representations of any person or persons desiring to be heard on any and all of the three subjects: the necessity, the nature and the estimated cost and only such objections as pertain to these shall be heard or considered at the preliminary hearing. (L. I. Act 406 Zeigler vs. City of Chicago 213 Ill. 61.) If necessary the Board may adjourn the meeting from time to time and no further notice need be sent to the property owners.

In case any person shall appear to object to the proposed improvement, or to any part thereof, the Board need not abandon the resolution, but they have the power to and "Shall adopt a new resolution abandoning the proposed scheme or adhering thereto, or changing, altering or modifying the extent, nature, kind character, or estimated cost of the improvement without further hearing thereon, as it shall consider most desirable and where said alteration does not increase the cost in excess of twenty per cent. of the amount estimated, no new hearing is required nor need a new estimate be submitted to the property owners.

If the proposed improvement is not abandoned, or is not stayed by a remonstrance petition, the Board of Local Improvements shall prepare an ordinance covering the proposed work and submit the same to the corporation authorities for passage. The ordinance shall prescribe the nature, character, locality, and description of the improvement, state whether it is to be

paid for by special assessment, special taxation of contiguous property, or part by special assessment and part by special taxation, and it must describe within a reasonable degree all property, if any, that is to be taken or damaged.

The ordinance should also provide for payment by installments, usually five (but not to exceed ten) and that "the first and subsequent installments be equal in amount, except that all fractional amounts shall be added to the first installment so as to leave the remainder equal in amount and each a multiple of one hundred dollars." Also "Installments shall bear interest as herein provided until paid, at the rate of five per centum per annum. Interest on assessments shall begin to run from the date of the first voucher issued on account of the work done as aforesaid. The interest on installments on each installment shall be payable as follows: On the second day of January, next succeeding the date of the first voucher, aforesaid, so certified as aforesaid, the interest accrued up to that time on all unpaid installments shall be due and payable and be collected with the installment, and thereafter the interest on all unpaid installments then payable shall be payable annually and be due and payable at the time as the installments maturing in such year and shall be collected therewith." Any property owner may, if he so desires, pay the whole assessment against any lot or parcel of land, or any installment at any time with interest up to the date of payment, but no installment can draw interest unless the assessment is payable in more than one installment.

An ordinance shall also be presented to provide that a sum of not more than six per cent. of the total assessment shall be applied toward the payment of the costs and expenses of levying the assessment of letting the contract, etc. These costs shall be paid out of the first assessment. (L. I. Act Sec. 94 427 Hurd's Rev. Stat.). The ordinances must be passed before the assessment roll is confirmed by the proper court.

The corporate authorities may refuse to pass any ordinance presented by the Board of Local Improvements except where the proposed improvement is the result of a petition of not less than half of the property owners abutting on said improvement. But there is nothing in the Local Improvement Act to prevent the presentation of a new ordinance covering substantially the same improvement, in case the corporate authorities refuse or neglect to pass, after a reasonable time, the ordinance first presented. It is seldom, however that mature deliberations and investigations of the board as expressed in an ordinance and submitted to the council or village board, are rejected by the latter.

The ordinance when presented to the village board shall be accompanied by a recommendation, signed by a majority of the Board of Local Improvements. This recommendation shall be prima facie evidence in court that all the preliminary requirements of the law have been complied with and if a variance be shown in court, it shall not affect the validity of the proceedings unless the court determine the preliminary requirements which may have been omitted or neglected were with fraudulent intent. (Sec. 8 L. I. Act. McChesney vs. City of Chicago 205 Ill. 611). This recommendation need not be signed by the president nor the secretary so long as a majority of the members affix their signatures. (Sec. 6 L. I. Act. Dodge vs. City of Chicago 201 Ill. 68. Gage vs. City of Chicago 194 Ill. 490).

The Board of Local Improvements has no power to accept a contract which is vitally different from the proposed improvement as first presented and on which a public hearing was held but, acting in good faith, the board may accept an improvement of the same general character as that specified in the ordinance and the contract although constructed with trifling defects and differences from that contracted for and the action of the board will be binding on the property owners. (Gage vs. People 200 Ill. 432. Gage vs. Springer 211 Ill. 200). This wise decision permits the exercise of the ordinary changes in a contract for a local improvement such as is always necessary on any work due to conditions which cannot be foreseen or provided for without an unwarranted expenditure of money for preliminary investigations, etc.

The Local Improvement Act and the various amendments to the Act cover several other questions that are pertinent to the construction of an improvement under the Act. These and various forms of ordinances, resolutions, recommendations etc. should be taken up with or referred to an attorney specializing, or at least thoroughly familiar with the necessary procedure specified in the Act as has been interpreted by the courts.

Local Improvement—How Determined

As will be noted from the above, the whole question of making an improvement under the Local Improvement Act depends on what is a local improvement as provided for under the Act.

In a general sense, all improvements are local in that they do not extend to all parts of the state. This, however, is not what is meant by the constitution nor expressed in the terms "Local Improvement" when spoken of in the statutes, and particularly in the "Local Improvement Act." An improvement that may be local in its nature but does not specially benefit the property assessed and is not enjoyed by the property of the municipality in general lacks the essential of a "Local Improvement." For instance a High School built and paid for by a certain section of a city (school district) is not embraced in the act. But, the laying of water mains along a particular street for the use of the inhabitants thereof is held to be strictly a local improvement. (McChesney vs. City of Chicago 152 Ill. 543. Morgan Park vs. Wiswall 155 Ill. 262). So too, service pipes of individual owners are held to be a local improvement. (Palmer vs. City of Danville, 154 Ill. 156.)

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In view of the legal question involved in constructing a water works system under the Local Improvement Act, I have referred this phase of the question to Mr. Dan'l M. Healy (Healy, Litzinger, & Reid, Attorneys) of Chicago. The substance of his report to me is as follows:

"The erecting of a reservoir or elevated tank for fire protection of certain parts of the city or of certain property is a local improvement and the cost of the same can and properly should be assessed against the property benefited.

"If a proposed water works system will be of benefit to a certain section of a city, or to certain property therein, as distinguished from the village as a whole, then and in that case the improvement can and should be installed as a Local Improvement and the cost of the improvement should be assessed in accordance with the provisions of this act.

"If the water works system be installed to embrace the whole of the property in the municipality, then and in that case, the improvement could not be considered as being embraced in the provisions of the Local Improvement Act, and the improvement should be made under an ordinance which provided for the payment to be made either under, or by, a general tax or by a bond issue. In this case, it would come under the constitutional five per cent. prohibition.

"Whether or not the improvement is "Local" is a question of fact; and the decision rests with the Board of Local Improvement, and their decision is final as to whether it shall be made by 'Special Assessment.' Special Taxation of the contiguous property, General Taxation, or a combination of the latter with either of the others."

Use of Explosives in Breaking up Concrete Piers Inside of Buildings

By Frank A. Huntington, New York, N. Y.

In the cellar of a factory building at Batavia, N. Y., there was a concrete pier 12 ft. high and 6 ft. square that the owner desired taken out. There was machinery nearby on one side and windows directly above on the other.

In building the pier, the concrete had been poured into forms in courses or tiers in the usual way, the junction between the courses being plainly marked. These courses were from 2½ to 3 ft. thick.

Selecting these junctions as the weakest point of attack, I drilled holes into the column 18 to 20 ins. deep and 1½ ins. in diameter. From three to five holes, usually one on all four sides of the column, were drilled.

For the upper courses, I loaded ¼ lb. of 20 percent dynamite in each hole, well tamped in with moist clay. For the sake of safety, only one or two holes were fired at a time. Had it not been for the danger of breaking the machinery, windows, or the floor above the pier, better results could have been obtained by firing all of the holes together.

Where more than one hole was set off at the same time, it was necessary to use electric blasting caps connected up with a blasting machine circuit, because in no other way is it possible to make charges go off at exactly the same instant and unless they do go off that way, the result is not satisfactory.

After loading the holes, blasting mats were made of burlap bags bound together to a thickness of about 4 ins. and thoroughly saturated with water. These mats were hung over the bore holes to prevent any flying chunks of concrete damaging surrounding objects.

In all, about 10 lbs. of dynamite were required to break up the pier. The dynamite cost $2.50 and the blasting caps about $1.25. Labor cost amounted to considerably less than a day's time.

Trade Note

The Van Wie Pump Co. of Syracuse, N. Y., successors to the Baldwinsville Centrifugal Pump Co., established in 1860, sold their business on September 8, 1919, to the East Iron & Machine Co. of Lima, Ohio. With this change the oldest centrifugal pump manufacturing concern in North America retires from the field. The business was established at Baldwinsville, N. Y., in 1860 and was first conducted by White, Clark & Company. Later, the name was changed to The Baldwinsville Centrifugal Pump Company. In 1880, the factory was removed to Syracuse, N. Y., and in 1905 it was incorporated as the Van Wie Pump Company. The line manufactured includes vertical and horizontal centrifugal pumps, double suction pumps, sand pumps, hydraulic dredge pumps, single action triplex pumps and vertical steam engines. It includes pumps suitable for, and adapted to, every industry where pumps are used—contractors, irrigation, mills, factories, dry docks, water works, dredges, etc. Thousands of these pumps of various types are in use throughout North America and are now operating in many of the largest plants and industries. The East Iron & Machine Company at their plant in Lima will at once begin to manufacture the entire line, as well as make parts and repairs for all Van Wie products. It is also their intention to make improvements on several of the pumps, which will greatly increase their efficiency. Their engineers are now working on this, and the Van Wie line of pumps will be developed to the limit of modern engineering skill. Established in 1903, the East Iron & Machine Co. occupies an enviable position in manufacturing circles. They build Merriman Steam Melting Asphalt Plants, and complete lines of machinery for the Chemical, Food and Allied Industries.

BEST EXTENSIBLE TRENCHING BRACE MADE
KALAMAZOO F'DRY & MACHINE CO. MICHIGAN
594 EAST MAIN STREET.

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Shear, Flap and Butterfly Valves
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Seasonal advertising has long been practiced by advertisers in magazines addressed to the public works field. Monthly magazines, in this field, for many years have annually reached the peak of advertising patronage in the April issue. With weekly magazines the first issue in April is normally the big issue of the year in advertising patronage.

Why is this? The practice rests on the known fact that the purchases of equipment and materials of construction are made in maximum numbers in the spring, when contractors get their first jobs of the season, and when buying is naturally stimulated in all quarters by the opening up of the construction season.

This plan of advertising, while logical in part and based on knowledge of the field, has its rather serious limitations. These limitations grow out of the fact, also well-known, that: "You can't make a good friend in a day."

Advertisers should never lose sight of the fact that contractors and engineers have their greatest opportunity for reading and study between busy seasons. It is during these comparatively quiet months of late autumn and winter that contractors and engineers are making mental note of the equipment and materials that they will buy or specify for the next season. When the spring rush comes these men are engrossed in numerous pressing duties. They buy or specify the equipment or material that appealed to them as best during their winter reading. This is especially true of the materials of construction. It should also be kept in mind that the planning and specifying season does not coincide with the construction season, in all cases, or even as a rule.

The time to educate a man is when he has time to read and study.

Advertise now for the business you desire to secure next season in the public works field.

Write for rates, circulation data, etc., to

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Contracts Awarded

ROADS AND STREETS

Ariz., Phoenix — Southwestern Constr. Co., Phoenix, award. contr. to construct Sec. 1, Tempe-Mesa Hwy. thru town of Tempe, at $34,705. State will furnish cement & reinforcing steel to cost $7,058.54; pavement will have a 5-in. conc. base and 1½-in. bithu. surface; McElrath and Shumway, Mesa, award. contr. to construct Sec. 2 of same road out of Mesa (state to furnish cement & other materials estimated to cost $47,556.95) at $115,200.

Ark., Ashdown—Jas. G. Sanderson, City, award. contr. for bldg. 18 mi. gravel road in Road Dist. No. 7, at $126,000; Post Pipe Co., Texarkana, awarded the contract for culvert work.

Ark., Batesville—L. D. Waggoner & Co., award. contr. for bldg. portion of Little Rock-Mammoth Springs Hwy. thru White Co., at $190,000.

Ark., Bentonville—Burnham & Zinc, Okla. City, award. contract for construction of 41.72 miles hard surf. road, at $207,000.

Ark., Jonesboro—J. E. Edwards Co., award. contr. for bldg. Lord Road from Jonesboro to Egypt, about 18 miles, at $250,000.

Ark., Little Rock—R. E. Martin, De Queen, Ark., award. contr. for bldg. 18.6 miles gravel road, conc. bridges and culvts. at $140,000.

Ark., Little Rock—Miller & Bowers, Lonoke, award. contract for grading and draining 2 3miles highway in Lonoke Co. Rd. Dist. No. 11, at $104,530.

Ark., Little Rock—Adamson & Hayes, Rogers, Ark., award. contracts for constructing abt. 100 miles of highway at cost of approx. $650,000, exclusive of culverts and bridges; Pioneer Bridge Co., Kansas City, award. bridge contract. Bridges will be of steel.

Ark., Little Rock—C. A. Rees & Co., A. O. U. W. Building, award. contr. to improve 69 miles of road at $518,000; S. E. Evems Co., 26½ mi. gravel rd., bridging culvts., etc., at $129,000.

Ark., Stuttgart—Miller-Butterworth Co., Little Rock, awarded contr., for construction of 33 miles of road, which is to be built of warranite material, at $1,144,931; Gregory & Wilson, Little Rock, awarded contr. for 40 miles gravel road, at $414,279.

Ark., Texarkana—Jim C. Sanderson, local, award. contract for 18 miles of road to be built in District No. 8, at $126,000.

Cal., Fresno—Thompson Bros. award. contr. for improv'g. E Street, Fresno St., to Merced Street, at $3.75 per sq. ft. for 20,800 sq. ft. of grading, 22.85c per sq. ft. for 19,200 sq. ft. paving, 23.85c per sq. ft. for 1,600 sq. ft. gutter and 60c per lin. ft. for 800 ft. curb; Thompson Bros., also award. contract for improving Thomas Ave., at $2 per sq. ft. for 62,081 sq. ft. grading, 3.5c per sq. ft. for 38,536 sq. ft. oiling, 65c per lin. ft. for 2,419 ft. curb. and 19c per sq. ft. for 9,807 sq. ft. walk; California Rd. & Street Impvt. Co., award. contr. for improving Ventura Ave., R. St. to Santa Fe Ave., at 3.75c per sq. ft. for 27,536 sq. ft. grading, 22.85c per sq. ft. for 25,844 sq. ft. paving, 58c per lin. ft. for 846 ft. curb and 23.85c sq. ft. for 1,692 sq. ft. gutter.

Cal., Hanford — Blanchard, Crocker & Howells, San Francisco, award. contract for paving abt. 1¼ miles of city streets at $109,303.

Cal., Holtville—Geo. R. Daley, San Diego, award. contr. for paving several streets at about $200,000. A 5½-in. pavement will be built.

Cal., Los Angeles—White & Gaskill, 356 Hermosa Ave., Long Beach, award. contr. by Bd. Supvrs., Los Angeles Co., for improving 14.19 miles Sierra Madre Rd., near Lancaster, 18 ft. wide, at $218,000.

Cal., Los Angeles — Chas. T. Salata, award. contr. for grading, oiling, constructing conc. gutter, culvts. and wall in Cahuenga Ave., Darien St. to 600 ft. southeast of Cahuenga Trial, at $2,176; White & Gaskill, Long Beach, award. contr. for constructing oil macadam rd. with disintegrated granite base on Sierra Madre Rd., Hovey Ave., A St., and Reed Rd., in Rd. Impvt. Dist. No. 149, at $218,000.

Cal., Martinez—Blanchard, Crocker & Howell, 58 Second St., San Francisco, award. contr. for constructing 3 mi. of road on Div. 14 of county hwy., betw. Oakley and Knightson, at $83,616.

Cal., Oakland—Pendergast Constr. Co., Los Angeles, awarded contr. for constr. of a sect. of conc. rd., betw. Santa Clara river and Williams ranch, Los Angeles Co., at $37,998.

Cal., Sacramento—Contracts for state hwy. work award. by Comn. as follows: F. C. McIntire, Stockton, contr. for paving with conc. 3.6 mi. state hwy. Santa Barbara Co., at $38,116; Bryant & Austin, Inc., 1,636 Compton Ave., Los Angeles, contract for paving with conc., and asph. surf., 5.2 mi. state hwy. in Los Angeles Co., at $48,-175; Geo. R. Curtis, 2,440 E. 26th St., Los Angeles, award. contract for conc. paving and asph. surf. on 8.4 mi. state hwy., Orange Co., at $86,550; Erickson & Petterson, San Francisco, award. contr. for grading 9.4 miles state hwy., Lake Co., betw. west boundary and Lakeport, at $116,100; Palmer & McBryde, San Francisco, award. contr. for conc. paving on 12.8 mi., state hwy., in Stanislaus Co., at $157,942.

Cal., San Diego—Fairchild-Gilmore-Wilton Co., Los Angeles, award. contract for paving portions Morena Blvd., at $96,387.

Cal., So. Pasadena—Wm. Liddington, 420 E. 60th St., Los Angeles, awarded contract for paving with concrete Orange Grove Ave., Mission St., to north city boundary, at $34,024.

Colo., Denver—Jas. V. Stryker, Denver, awarded contract for grading, curbing, surfacing cross walks, etc., on certain hwys. in Harman Impvt. Dist. No. 1, at $110,698.

Ct., Hartford — A. Vito Constr. Co., Thompson, awarded contract for constr. of 18,410 ft. macadam rdway in Thompson for $75,000.

Conn., Milford—C. W. Blakeslee & Sons, 58 Waverly St., New Haven, award. contr. for bldg. 5,000 ft. asph. rdway on Broad Street, at abt. $32,000.

Fla., Haines City—Southern Road Bldg. Co., Tampa, awarded contr. for constr. of paved streets and storm sewer, at approx. $110,000.

Fla., Seabreeze—Alabama Paving Co., Birmingham, Ala., award. contr. by city for paving portions of 7 streets; grouted brick, at $168,300.

Idaho, Boise—Grant Smith & Co., Seattle, Wash., awarded contract for constr. of part of the North and South Hwy, betw. the mouth of Whitebird Creek and New Meadows, at $625,000.

Ind., Anderson — Madison Constr. Co., award. contract for bldg. 4 miles conc. road in Monroe Twp., at $117,750.

Ind., Indianapolis—Federal Paving Co., Chicago, award. contr. for construction of 11.5 miles of rdway in Lake Co., at $375,-156.

Ind., Mitchell—Wabash Constr. Co. Vincennes, awarded contract to build 12 miles concrete road along route of Dixie Hwy., thru this county at $503,257.

Des Moines, Ia.—Jas. Horribon Co., 14th & Mulberry, award. contr. for asph. conc. paving, Cl. A on W. 21st St., at $3.59; Wright Construction Co., contr. for paving on E. Court St., at $3.69; Potts Bros., contr. for curbing on Guthrie Ave., at 49½c and on 21st St., at 49½c. Thos Cary & Sons, 509 Youngerman Bldg., contr. for paving and curbing Ft. Des Moines Rd., at $140,377.

Ia., Dubuque—Jos. F. Lee, 17 Almond, award. contr. for paving Grandview Ave., at $88,000.

Ia., Griswold—Aikin & Flutter, Corning, award. contract for constr. of 26 blocks of paving at total cost of $130,000.

Kans., Independence—J. K. Shinn, local, awarded contracts for paving following streets: portion of Chestnut, Walnut, Third, Sixth, S. 12th St., alleys in blks. 20, 39 & 66, at $123,341.

Kans., Washington—Stranton Construction Co., Leavenworth, awarded contract to pave various streets at $100,000.

Ky., Louisville—Speed & Parker, Louisville, award. contr. for re-construction of 3 miles of Bardstown and Louisville turnpike, at $65,336.

Me., Augusta—Small & Ingalls, Bar Harbor, only bidder for paving .21 mi. bitum. macad. rd., Brunswick Twp., at $9,246; A. D. Bridges & Son, inc., Hazardville, award.

Does your concrete set properly?

If not, don't put the blame on the cement—it has been tested at the mill and must come up to the required standard before being shipped to you.

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Do you know before using it that it is good Sand—sand that will insure satisfactory results when used with good cement?

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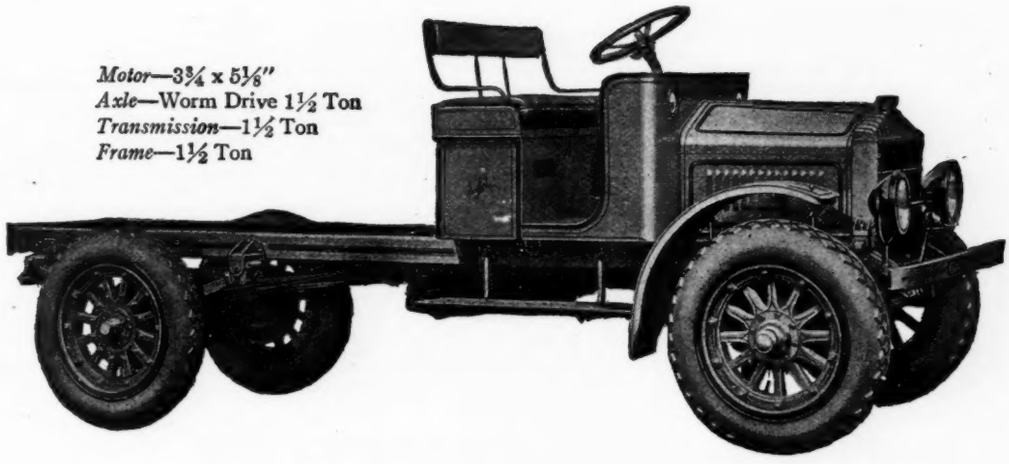
Pneumatic Cord Tires, 36 x 6" all around
Power Tire Pump & Extra Rim, $285 extra
Electric Lighting and Starting, $125 extra

Motor—3¾ x 5⅛"
Axle—Worm Drive 1½ Ton
Transmission—1½ Ton
Frame—1½ Ton



A New Garford Model—1¼ Tons Capacity—of True Garford Quality—at a Remarkable Price

THIS new Garford of 1¼ ton capacity is possessed of the same rugged qualities which have made Garfords known wherever staunch service and long endurance are required.

It is a Garford—*through and through*—practical in design, finished in workmanship.

It is a motor truck equipped with every necessity to fit it for hard, continuous work.

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This new Garford Model is unquestionably a "*mighty husky 1¼ ton truck.*" It merits the attention of those interested in securing the ***low cost ton mile*** delivery. See it at the nearest Garford salesroom.

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Motor Trucks of all Capacities

Distributors and Service Stations in all principal cities

contr. for grading, draining and surfacing 9.35 miles Riverside Dr., 16 ft. wide, Vassalboro Twp., at $253,273.

Mass., Boston—Coleman Bros., awarded contract for constr. of new highway around Shelburne mountain—Greenfield to Shelburne Falls; 5½ miles long. State will receive from national government $20,000 a mile toward cost of bldg. this road.

Mass., Milford—L. Luchini & Son., award. contr. to construct 2½ mi. of State Rd., in towns of Agawam and Southwick, at $30,000.

Mich., Detroit—City let contract paving with sheet asph. on 6-in. concrete fdn., Medina curbstone portion of Epworth Blvd., to W. B. Brady, constr. Co., 1972 Grand River Ave., at $58,759; Detroit Asph. Paving Co., 20 McGraw Blvd., contr. for impvt. section of same Blvd., at $50,916.

Mich., Grand Rapids—Golden & Boter, award. contract for constr. of Assessment Rd., No. 19, at $51,241.

Mich., Lansing—State Hwy. Dept., let contract for grading, draining and surfacing Assessment Dist. Rd. No. 256, 6.485 mi. macadam, to Skeldon and Ryan Constr. Co., Box 172, Central Sta., Toledo, O., at $133,706; 1.176 mi. concrete, to Hilding & Robe, Roga, at $35,911; also grading & surfacing 7.083 mi. State Trunk Line Rd. No. 25-3, involving 66,485 sq. yds. gravel, to Bd. Luce Co. Rd. Commrs., Newberry, $68,000.

Mich., Newberry—W. T. Keating, 6707 Sheridan Rd., Chicago, awarded contract for road work in Luce and Chippewa Counties, at $151,276.

Miss., Columbus—H. C. Terry, award. contr. for paving streets in business district at $44,600.

Mo., Moberly—Lynch-McDonald Constr. Co., Moberly, awarded contr. for paving practically entire town of Rockport, Mo., which involves expenditure of $225,000.

N. J., Atlantic City—Sampson & Reuter, Elizabeth, N. J., awarded contr. for re-constructing sec. of White Horse Pike in city of Absecon and Gallway Twp., Atlantic Co., at $104,231.

N. J., Camden—McInery & McNeal, Philadelphia, award. contract for re-bldg. east end of King's Hwy., Haddonfield to Haddon Heights, at $42,948.

N. J., Hoboken—A. Lottieri & Son Co., 261½ Wayno St., Jersey City, contract for repaving 6th and 7th streets, Washington St., to Bloomfield Ave., granite block, at about $117,000.

N. J., Jersey City—Wm. Van Keuren, Grand and Prior Sts., Jersey City, award. contract for paving with granite blk. on present conc. fdn. the rdway of Newark Ave., Summit Ave to Westerly line of West Side Ave., excepting portion betw. tracks at $55,388.

N. J., Trenton—J. J. Barrett, 147 Lafayette Ave., award. contract for repaving E. State St. and Whiteheads Rd., sheet asph. and vitr. brk. on Portland Cement conc. base, at $53,099.

N. Y., Brooklyn—Following contracts let by E. Riegelmann, Boro. Pres.: Sicilian Asph. Paving Co., 41 Park Row, N. Y. City, for regulating and repaving Atlantic Ave., Washington to Classon Aves., at $40.547; Atlantic Ave., Classon to Bedford Aves., at $41.582, Bedford Ave., $10,220, Sprague alley $832; to Scott & Kurth, 411 Sackett St., Classon Ave., $131,145; Grimm Constr. Co., 460 Herold Ave., E. 18th St., at $3,633, Vermont Ave., $4,611; Uvalde Asph. Paving Co., 1 Bway., New York City, E. 18th St., Ave. O to Ave. P., at $12,650; Consolidated Asphalt Paving Co, 52 9th St., 83rd St., $11,614, 83rd St., 19th to 20th Aves., at $11,952.

N. Y., Fredonia—P. B. Colgan, Dunkirk, awarded contract for paving with brick, Eagle Street, at about $52,000.

N. Y., New York—Following contracts let by Pres. Manhattan Boro.: M. I. Sachs, award. contr. for regulating and repaving with granite blks. on conc. base intersect. of Bway at $3,101; with sheet asph. on conc. base rdway of Bway., to Sicilian Asph. Paving Co., 41 Park Row, at $54,413; 28th St., to Cleveland Trinidad Paving Co., Flushing Aves., Brooklyn, $27,071; 110th St., to Uvalde Asph. Paving Co., 1 Bway, at $35.404; Lenox Ave., to J. L. Brussrar; Harlem River & 150th St., $47,799; Lexington Ave., sheet asph. and wood blk., to Asph. Constr. Co., 2197 Madison Ave., at $230,618.

N. Y., St. George, S. I.—J. E. Donovan, Port Richmond, award. contr. for repaving Richmond Terrace, Western Ave. to Elizabethport Ferry, at $6,300; Wadsworth Ave., $3,750; C. Vanderbilt, 24 Elizabeth St., W. New Brighton, Richmond Terrace, at $47,493; Johnsons Sons, Pt. Richmond, Castleton Ave., $3,800; Bay St., $2,825, Lindenwood Rd., $1,170; Leedecker & Sachs, Brook St., at $11,680.

N. Y., Willard—Jas Conley, Ithaca, award. contract to complete the Willard-Ovid Rd., 2.13 miles, at $45,730.

O., Akron—Bates & Rogers Constr. Co., Cleveland, award. contract for bldg. highway from high level brdg. to county line (17 mi.) at $850,000. Road will be built of rein.-conc.

O., Cleveland—City let following contracts: Freshwater Paving Co., 11712 Detroit Ave., contr. for paving Loretta & Fidelity Aves., brk., at $19,905 and $10,171, respectively; American Paving Co., Marshall Bldg., Franklin Ave., asph., $40,995; Baldwin Bros., 4500 Euclid Ave. Kinsman Rd., asph., $72,255; A. M. Pejsa, 2359 93rd St., sect. of Kinsman Rd., brk., $75,155 and Superior Ave., $96,913, another section Superior Ave., wood blk., $96,964; Burnett Hathaway Co., Society for Savings Bldg., sect. of E. 4th St., $12,614 (wood blk.); G. B. Herring, same bldg., sect. of Westfield Ave., brk., $10,548; Roehl Bros., W. 25th St. and Clark Ave., sect. of W. 44th St., brk., $12,045.

O., Cleveland—Freshwater Paving Co., 11712 Detroit Ave., award. contract for paving Henley Ave., W 92nd to 99th Sts., at $10,199; Nordica Ave., W. 73rd to 80th Sts., at $10,558.

O., Cleveland—Masters & Mullen, award. contr. for paving 5 mi. Wilson Mills Road, Wilson Mills to So. Center Rd., at $190,000; brick.

O., Columbus—A. G. Pugh, City, awarded contract for improvement of St. Clair Ave., Mt. Vernon Ave., to viaduct, at $36,802.

O., Columbus—Serv. Direct. Geo. A. Borden awarded following improvement contracts: Third St., resurfacing over present brk. pavement with asph., to Franklin Asphalt Paving Co., Columbus, at $57,234.

O., E. Liverpool—Geo. Patterson, awarded contract for completing the Calcutta and Fredericktown Rd., at $21,725; Geo. B. Patterson, Wellsville, award. contract for repaving W. 8th St., & Lisbon Sts., betw. the Horn switch and McBride property.

O., Newark—L. B. Wilson, Newark, award. contr. for constr. of Cadiz-Carrollton road, Harrison County, at $75,119.

O., Toledo—M. F. O'Sullivan Co., awarded contract for paving with brick, Nevada Street, Spring Grove to city line, at $27,384; McKinney Bros., award. contr. for creo. paving on Bennett Rd., Sylvania Ave. to city line, at $30,868.

O., Youngstown—Seiple-Wolf Constr. Co., Youngstown, award. contr. for bldg. section of Canton-Dover Rd., at $38,579.

Pa., Butler—C. E. Walters & Sons, award. contr. for impvt. of Oak St., with a slag base, conc. curb and gutter with Clydesdale blk., at $3,190; Brugh Ave., including slag base, conc. wall and rein. conc. curbing, at $7,752.

Pa., Chartiers (Pittsburgh, P. O.)—J. B. Reed Co., McKees Rocks, award. contract for grading paving and curbing Lakewood Ave., Pittsburgh City line to Oak Street, at about $13,000.

Pa., Connellsville—J. L. Brown, Uniontown, awarded contract for bldg. 7,335 ft. concrete road, 18 ft. wide, to be known as McClelland town road, at about $65,000.

Pa., Ebensburg—Lord & Clark, Hastings, award. contract for constr. of 17,000 ft. brk. on concrete road in Allegheny Twp., Bradley Jct., to Loretto Boro. Line, at $182.230.

Pa., Harrisburg—Following contracts awarded by State Hwy. Dept.: Route 9, Lackawanna Trail, 71,003 ft., Clark, Summit, Glenburn, Dallon and La Plume Boroughs, and Abington Twp., to Ruthven, Rees & O'Brien, Scranton, at $460.327; Route 232, Luzerne Co., 31,418 ft., West Pittston, Exeter Boro. and Twp. to Richardson Hand, Wilkes-Barre, at $228,548; Route 150, 812 Ft. Morrisville Boro., Bucks Co., to T. Guy Meyers Co., Inc., Philadelphia, at $13,914.

Pa., Harrisburg—State Hwy. Department awarded following contracts for road improvements: W. P. MacDonald Constr. Co., Philadelphia, 7,857 ft. constr. in Adams Co., Gettysburg Boro., at $109,769; Norman J. Boyer, Butler, Pa., 14,044 ft. rein. conc., Butler Co., Slippery Rock Twp., at $134,699; J. H. Hileman Constr. Co., New Kensington, Pa., 16,417 ft. rein. conc., Clarion Co., at $164,870; M. Bennett & Savage, Warren, Pa., 7,936 ft. rein. conc. Warren Co., at $60,689; Adams, Wyans & Co., 30 Church St., N. Y., City, 24,112 ft. constr., in Tioga Co., Lawrence Twp., at $191,286.

Pa., Lebanon—Contracts for paving Sects. 1 and 2 of streets from Cumberland to Mangan Sts., let by City to Pugh & Dolan, Pottsville, at $7,521 and $23,688, respectively; Sect. 3, 10,000 sq. yds. 2-in. bitum. on 5-in. concrete base, to H. Neumeyer, Bethelehem, at $38,128.

Pa., Waynesburg—E. E. Morris, Waynesburg, award. contract by Commrs. Greene Co., for bldg. conc. and vitr. brk. road from Dry Tavern on Waynesburg Rd., at $319,732.

Pa., Wilkes-Barre—Richardson, Hand, City, award. contr. for improving W. Pittston and Exeter Boroughs Hwy., at $228,548.

S. D., Deadwood—Anderson Constr. Co., Rapid City, S. D., award. contr. for grading, surfacing with gravel and furnishing & installing corr. met. pipe with conc. headwalls on 11.4 mi. road, Whitewood to Spearfish, at $73,211; also contract for 11.4 miles road, Spearfiish to Wyoming line, grading, furnishing & installing corr. met. culverts, with conc. culvts. and small brdgs. at $90,097.

Tex., Abilene—Sanders Bros., Miami, Fla., awarded contract for 4.7 mi. road, gravel surface; conc. draing. struct; $21,012.

Tex., Montague—Following contracts let by Montague County Commrs.: Harris & Powell, 600 Ellis Ave., Tyler, Tex., $51,000; 10-mile gravel road; Womack Constr. Co., Houston, Tex., $140,000, 50 mile sand-clay roads and conc. bridges.

Tex., San Antonio—Chapin-Colglazier Constr. Co., awarded contract for improving 9 miles Culebra Road at 60c per sq. yd. for 1-in. Uvalde Rock asph. laid cold. Total cost of surf. treatment will be abt. $36,000.

Utah, Spanish Fork—Wattis-Samuels Co., Newhouse Bldg., Salt Lake City, awarded contract for paving Main and various other streets, at $153,014.

Wash., Everett—J. W. Hoover, Everett, award. contr. for paving Norton Street with approx. 8.171 yds. concrete at $30,717.

Wash., Kelso—Henry & McFee, Seattle, award. contract for grading and graveling last sect. of Pacific Hwy., to be brought to perm. grade, at $241,317. This work involves much heavy grading, particularly at Tom Brown Hill. Project includes 7 miles north from Castle Rock.

Wash., Olympia—State Highway Commission let contracts for state highway work as follows: Pacific Highway, Seattle to Lake Forest Pk., to J. L. Smith, Seattle, at $121,281; Olympia Hwy., from Forks south to R. O. Wahlgren of Forks, at $29,932; Inland Empire Hwy., Ellensburg so. to Rajotte, Hobart and Winters, Spokane, at $198,533; National Pk. Hwy., La Grange to Alder to Sweeney & Galluci, Tacoma, at $147,297.

Wash., Ritzville—Robt. A. Sloan, L. C. Smith Bldg., Seattle, awarded contr. for 21 miles hwy., impvt. at $131,274.

Wash., Toppenish—Standard Asphalt Co., awarded contract for improvements here at $84,338.

Wash., Winlock—Ford & White, Seattle, award. contract for hard surfacing 1.5 miles of roads, concrete, at $24,712.

W. Va., Berkeley Springs—Sims & Torrington, 326 Commercial Trust Bldg., Philadelphia, award. contract for bldg., 2 miles Berkeley Spring-Hancock Rd., at $42,000.

W. Va., Beckley—Vaughn Constr. Co., Williamston, award. contract for paving 8.5 miles Giles, Fayette and Kanawha Turnpike, 9 ft. wide, penetration macadam with 3-ft. broken stone shoulder, at about $90,000. County will furnish asphalt.

W. Va., Huntington—Following paving contracts let by City Commrs.: Geo. Hinkle, Locust St., at $6,456, and 19th St. at $1,795; Duncan & Griffith, N. Lincoln St., at $1,162; 3rd & 4th Sts., at $17,960; Amos Trainor, 11th., 10th and other streets at $5,062; all Carlisle blk.

W. Va., Keyser—H. W. Kaylor & Co., 106 Arcade Bldg., Hagerstown, Md., award. contract by Commrs. Mineral Co., for bldg. Elk Dist. Rd., at $247,626.

W. Va., Martinsburg—Richard R. Feller Co., award. contr. for 16-ft. bitum. macadam pavement on 8 mi. Martinsburg and Winchester Rd., at $94,331.

Wis., Barron—Swanson & Johnson, 5816 Oakes Ave., Superior, Wis., award. contr. for Barron-Turtle Lake Rd., Fed. Aid Proj. 101, at $48,797.

Wis., Beloit—McCullough & Cheney, 440 Temple Court, Minneapolis, Minn., awarded contract for Beloit-Janesville Rd., Proj. No. 96, Rock Co., at total cost of $162,426.

Wis., Menasha—C. R. Meyer & Son Constr. Co., Oshkosh, award. contr. to build new pavement on Washington, Tayco, Water and 2nd Sts., at $33,000 for concrete paving.

Wis., Green Bay—J. Young, Ocontom, Wis., award. contract for Lake Shore Rd., Manitowoc Co., at $48,291.

SEWERAGE AND SEWAGE TREATMENT

Ariz., Phoenix—C. Fisher, 854 N. 6th Ave., award. contr. by City for bldg., tile draing. sys. at about $124,711.

Cal., Los Angeles—B. Dorage, award. contr. at $1,995 for constructing sewer in Ridgewood Pl., First to Temple Sts.; Miko Chutuk, contr., for constructing cement pipe sewer in Broadway, Pico to 10th Sts., at $3,209; also pipe sewer in Denver Ave., Slauson and so. terminus of Denver Ave., at $1,600; S. Zarubica, award. contr. for constructing cement pipe sewer in Lycille Ave., at $729.

Cal., Los Angeles—B. Deragno, awarded contract for constructing cement pipe sewer in Homer Street betw. no terminus and Ave. 23 and other streets in Homer street sewer district, at $35,807.

Cal., Los Angeles—Jno. F. Blee, Bldg. Industries Assb., 501 Stimson Bldg., award. contr. at $12,000 for constructing Manchester Ave., sewage pumping pit.

Cal., Los Angeles—Chas. T. Salta, award. contr. for constructing a cement pipe sewer in Lincoln Ave., west term. to Ave. 49, at $1,600.

Cal., Willows—John Heafey, award. contr. for digging and laying pipe for sewer in Sewer Dist. No. 2, at $16,066; H. C. Maddox, award. contr. for pipe at $9,622.

Conn., Bristol—Antonio Di Marco, Southington, awarded contract for construction of sewers on Lawndale Ave., Gridley St., Sunset Ave., George and Murray Streets.

Conn., Stamford—F. Palmer, 131 Sound View Ave., award. contract by City for bldg. brick and rein. conc. sewage disp. plant, rein. conc., flooring, conc. fdn., to include Imhoff tanks, sludge drying beds, storage basin and screen chamber and laboratory bldg., at about $225,000.

Fla., Leesburg—Owens & Harwell, Tampa, award. contract for installing 8 mi. sewers and 1 septic tank, at $38,771.

Ga., Augusta—Hallahan & Costello, awarded contract for constr. of terra cotta pipe sewer on Tubman street, Broad to Green Sts.; W. F. Bowie, Jr., contr. for sewer on Savannah Rd., 12th St., to Belt Line R. R. crossing.

Ill., Kankakee—Shidler Constr. Material Co., local, awarded contract for construction of Review Sewer, at $51,957.

Ill., Murphysboro—B. S. Craine & Co., Carbondale, awarded sewer contract at $42,000.

Ill., Rockford—Nick Santucci, Chicago, awarded job of installing sewers on Kent, Loomis and Sinnissippi streets in So. Rockford.

Ind., Ft. Wayne—Board of Works let following contracts for sewers: Anton Riege, Jr., contr. for sewer thru lots 5, 6, 7, 8, 9 and 10 of Koehler's Addn., from no. line of Rudisill Ave., to alley on no. line of Purman's Addn.; Fred H. Fuelling, betw. Winter street and Lillie St. from Hartman Ave. to Rudisill Blvd.; Fred H. Fuelling, sewer Betw. Lillie street and Anthony blvd. and from Hartman avenue to Rudisill blvd.

Ia., Cedar Rapids—J. L. Hansman & Sons, Des Moines, award. contr. for constr. of storm water sewer system at Hartley, at $24,397.

Ia., Chariton—P. E. Johnson, Chariton, awarded contract for sewage disposal plant at $24,970.

Ia., Davenport—Chris. Hanson, award. contr. for laying sewer on Middle Rd. and Fornwood Ave., at $1,209.

Ia., Des Moines—Johnson Bros., City, awarded contract for impvt. of Shriver Ave., by constructing sewer system at $1.56 per ft.; also septic tanks at $3,000.

Ia., Des Moines—Johnson Bros., awarded contract for sewer on Cornell Ave., at $1.45 per ft.

Ia., Livermore—National Constr. Co., Davenport, Ia., awarded contract for sewers and water works system at $65,000.

Ia., Pocahontas—J. W. Turner Impvt. Co., Des Moines, award. contr. for constructing sewers at $109,612; B. C. Viegel, Webster City, awarded contract for sewerage disposal plant at $21,900.

Ia., Strawberry Point—Rodies & Bales, award. contract for sewers at $6,378. Septic tank at cost plus 15 per cent. and filter bed at cost plus 10 per cent.

Ia., Villisca—W. C. Boise, award. contract for sewer Y extensions, 2,000 lin. ft.

Ia., Waterloo—Moore-Seig Co., award. contr. for sewer work to consist of lifting pumping station and laying several sizes of sewers in Soash Park Addn., and adjacent territory, at $47,184.

Ia., Davenport—Jno. W. Crowley of the National Constr. Co., local, awarded contract for sewage and water works at Livermore, Iowa, to involve expendt. of $65,000.

Ky., Richmond—Jno. B. McClane & Co., Newport, Ky., awarded contr. for constr. of storm and sanitary sewers here, at $67,860.

Mass., Boston—Timothy Coughlin, award. contract for bldg. sewerage works in Carson Street, Dorchester, at $7,669.

Mass., Boston—J. W. O'Connell Co., City, award. contract for laying 308 ft. 3-6 in. conc. sewer in Albany St., at $14,157. Work involves 700 cu. yds. earth trenching.

Mass., Boston—Jno. A. Costello & Co., award. contr. for sewerage works at Calf Pasture Pumping Station, at $5,368.

Mass., Dedham—J. C. Cavanaugh, 25 Medway St., Dorchester, award. contr. for laying 1,550 ft. 33x36 ft. rein. conc. sewer pipe, Wellesley Extension, at $47,675.

O., Lima—J. W. Farley, 118 N. LaSalle

USED ROAD BUILDING EQUIPMENT FOR SALE
AT REDUCED PRICES

1—Cummer 2000-yard Railroad Car Asphalt Plant.
1—Cummer 1800-yard Road Asphalt Plant.
1—Twelve-Ton, 24-inch Gauge, Geared Locomotive.
6—Road Rollers, 2½, 8 and 10-ton.
1—Noyes Crusher for Re-working Old Asphalt.

2—Brand New Traction Road Cranes, full Revolving.

Locomotive Cranes, Hoisting Engines, Buckets, Dump Cars and Other Equipment.

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St., Chicago, awarded contract for bldg. Collett St., Relief Sewer, No. 1, at $523,000.

Mass., Fairhaven — Tony Lapattula, 19 College St., Providence, R. I., awarded contract for constructing 1,200 ft. 15-in. pipe sewer, 460 ft. 10-in. 2 manholes, at $8,200.

Mass., Lynn — A Barrufaldi, Boston, award. contract for constr. of an addn. to the outfall sewer, at $28,396.

Mass., Needham—Rendle Stoddard Co., Chelsea, award. contract by Metropolitan Water & Sewer Bd., Boston, for laying 3,840 ft. 27x30 ft. concrete and 33x36 ft. rein. conc. sewer in Wellesley Extension, at $72,046.

Mass., Stoneham, (Boston, P. O.)—Rendle Stoddard Co., Chelsea, award. contract for laying 3,650 ft. 15-20 in. vitr. sewer pipes in Reading Extension, at $26,016.

Mich., Bay City—Wm. E. Grisdale will probably be awarded contract for extension to Belinda street sewer, at $5,043 as recommended by Board to Council.

Mich., Detroit—Merlo, Merlo & Ray, Walkerville, Ont., awarded contrs. by Ford Council to construct sewers on Dawson, Lawrence and Pelette Ave., at $12,968.

Mich., Detroit — Dickinson Real Est. Exch., 205 Old Whitney Bldg., will construct by day labor 12,226 ft. vitr. crock lateral sewerage system in Avon Pk. Subdivision. Abt. $20,000.

Mich., Lansing—E. J. Noyce, Lansing Mich., awarded contract for constr. of sewer in N. Highland Park subdiv., at $18,385.

Mich., Port Huron—C. Mugovero, Port Huron, award. contract for furnishing labor and material for bldg. complete lateral sewers in alleys No. 11 and 12, at $2,375; in sect. of Water St., $6,346; Nelson St., $3,588; Carleton St., $16,649, involving 9,732 ft. 8-15 in. vitr. pipe; J. Kaumeier, Port Huron, contr. for sewers in sect. of Bancroft St., $9,532 and Minnie St., $8,123, involving 4,152 ft. 8-15 in. vitr. pipe.

Mich., Redford—W. C. Hoy, Redford, award. contract for trenching and laying 35,000 lin. ft. 8-24 in. vitr. crock sewers, etc. in vicinity of Grand River Ave., at about $35,000.

Mich., Royal Oak—Thorp & King, Royal Oak, awarded contfact for bldg. 4,000 ft. 12-24 in. vitr. pipe sewers in Seven Mile Rd., Lincolnshire Land Co's Subdiv., involving earth trenching and 13 brk. manholes, at about $15,000.

Minn., Duluth — Jno. Hedberg, award. general contract for sewer in Grand Alley, 11th alley to 10th street, at $1,062.

Minn., Luverne—Thos. E. Woolley, LaCrosse, Wis., awarded contract for construction of storm sewer system, at $22,278.

Minn., Milica—O'Neil & Preston, 60 E. 6th St., St. Paul, award. contract for sewer exten. in Dist. No. 2; Milica Bridge Co., contr. for sewer exten. in Dist. No. 6, at $1,250.

Minn., St. Cloud — Bensen & Bretz, awarded contract for sewers on 7th Street, First to 2nd Sts.

Minn., St. Cloud—J. P. Benenius, St. Cloud, award. contract for bldg. 5 blocks 36-in. segmental sewers in Dist. No. 7, at $14,065.

Minn., St. Paul—Kircher Bros., Olivia, Minn., awarded contract for sanitary sewers, 17,000 ft. 8-in. to 12-in., at $34,350.

Minn., Waseca—W. C. Johnson, Jr., Waseca, awarded contract for laying 14,894 ft. tile drain, at $12,597.

Minn., Worthington—O'Neil & Preston, 60 E. 6th St., St. Paul, award. general contract for constr. of sewers.

Mo., Holden—J. O'Neil, Leavenworth, Kans., award. contr. for installing sanitary sewerage system and sewage disposal plant, at about $57,000.

Mo., Milan City—Jos. O'Neil, Contr., Leavenworth, Kans., award. contr. by City for district sewer No. 1: sanitary sewers, 11,000 ft. 8 and 10-in. pipe, septic tank, $28,400; disposal palnt for 1,200 population, $4,352.

Mont., Shelby—Two Miracle Conc. Co., 437 Ford Blk., Great Falls, awarded contract for installing sewage disposal plant and 10-in. sewer extensions at $10,450 and $25,289, respectively.

Mont., Shelby—Gerharz-Jaqueth Engrg. Co., awarded contract for sewerage system, at $35,000.

Neb., Alliance—Sprague & Nisley, Beatrice, Neb., awarded contract for constr. of storm sewer system.

Neb., Harvard—Dunlop & Co., Tecumseh, awarded contract for constr. of sewer system, at $57,695.

Nem., Spalding—Katz Constr. Co., 640 Brandeis Theatre Bldg., Omaha, award. contract for constr. of sewer system, at $32,700.

Neb., Wayne—Katz Constr. Co., 409 Brandeis Theatre Bldg., Omaha, award. contract for storm sewer, at $33,205.

N. J., Somerville—A. H. Conyne, Somerville, awarded contract for bldg. sewer in Main St., at $20,700.

N. Y., Binghamton—F. N. Lewis Co., inc., 108 Mary St., Herkimer, N. Y., award. contract for constr. of sanitary sewerage disposal power plant at $4,072.

N. Y., Buffalo—Village of Kenmore awarded contract to J. M. Pfanning, for constr. of the Elmwood trunk sewer from the government sewer in Curtiss field to no. end of village, at $15,002.

N. Y., Rochester—Whitmore, Rauber & Vicinus, 279 South Ave., award. contract for bldg. new sewage disposal plant in 23rd Ward, at $49,927.

N. C., Goldsboro—Sullivan, Long & Haggerty, Birmingham, Ala., award. contract for bldg., 9 mil. sewers, at about $100,000.

N. C., Williamston—J. L. McGhee Co., award. contract to install sewer and water systems; city will purchase all material; sewage-disp. plant, 50,697 lin. ft. 8 to 12-in. sewer pipe; 97 valves; 74 fire hydrants, etc.

N. D., Edgeley—Fraser & Danforth, 810 Guardian Life Bldg., St. Paul, award. contract for bldg. extensions to sewerage system, at about $85,900.

O., Chagrin Falls—Henderson Bros., award. contract for Russell Road sanitary sewer, at $1,739.

O., Cleveland—Manson Co., The Arcade, award. contract for laying 3,120 ft. 3-6 ft. 3-in. brick and 660 ft. 12-24-in. vitr. pipe sewers in Kinsman Road, E. 135th to East 140th Sts., at $75,771.

O., Lima—J. W. Farley Co., Chicago, awarded contract for two new sewers to be built in Lima, at $523,535 for the Collett street sewer and $234,438 for the Askins sewer.

O., Hamilton—Jno. H. Trunck & Son, City, award. contract to construct sanitary sewer from Third St. to a point near the old gas works, at $2,314.

O., Toledo—Gessner Co., and Thomas Sheehan, award. contracts for sewer construction at $9,240 and $3,451, respectively.

Okla., Tulsa—Tibbetts & Pleasant, award. contract for constr. of sewer system in District 156 at $2,653; Comestock & Hanson, contract for sewer in Dist. 159, at $5,054.

Ore., Portland—J. F. Shea, N. 2nd St., award. contract for bldg. sewerage system in E. 37th St. and Raymond Ave., at $40,655; in Harold and 55th Aves., at $154,755, both 8-in. vitr. pipe.

Pa., Erie—F. G. Diefendorf, award. contract for constr. of sewer, conc. and segment blk. construction, from 19th street and Mill Creek east to Parade St. then so. to Parade to a point 40 ft. so. of 23rd St., at $68,219; Erie Conc. & Steel Co., contract for constr. of sewer from a point 60 ft. so. of 26th St., at $11,703; V. Calabrese & Co., award. contract for extension of the Canal sewer at $10,373.

Pa., Pittsburgh—City let contr. for laying 100 ft. 9-in. vitr. and 760 ft. 12-in. rein. conc. sewer pipe in Fallowfield Ave., to F. F. Diulus, 40 Boundary St., at $2,429; 941 ft. 15-in. rein. conc. sewer pipe in Grandview Ave., to Critelli, Ricca and Zapp, 218 13th St., Sharpsburg, at $3,982; 204 ft. 10-in. rein. conc. and 2,130 ft. 8-in. vitr. sewer pipe in Richmond St., and 1,400 ft. 15-in. rein. conc. sewer pipe in McCandless St., to Manella and Lucenti, 6610 Rowan Ave., at $5,326 and $5,024, respectively.

Tenn., Nashville—T. I. Curtis & Son, award. contract for constr. of two sewers, at $4,655.

Tex., Corpus Christi—Dodds & Wedegartner, San Benito, Tex., awarded contract for conc. settling tanks; improvg. water works., etc., at $16,683.

W. Va., So. Charleston—McNichols Co., 924 S. Kilbourn Ave., Chicago, Ill., awarded contract for installing complete sewerage system at about $140,000.

Wis., Chippewa Falls—P. L. McQuillion Co., local, award. contr. for sewers at $80,000.

Wis., Manitowoc,—Gray-Robinson Co., N. 8th St., award. contract for excavating and laying 10-in. vitr. pipe sewer in Main and 10th Sts., at about $15,000.

Wis., Port Washington — A. McGrone, award. general contract for sewer and water mains in Main Street.

WATER SUPPLY AND PURIFICATION

Cal., Harper—J. L. Ackland, 818 S. Kingsley, Los Angeles, award. contr. by Newport Mesa Irrig. Dist. for bldg. circular conc. reservoir, 150 ft. in diam., 14 ft. deep, at $13,975. Contr. subject to approval of W. J. McClure, State Engr.

Cal., Wilmington—Bent Bros., Central Bldg., Los Angeles, award. contr. by Union Oil Co., Los Angeles, for bldg. 60,000 bbl. circular earth & concrete reservoir, 340 ft. in diam., 15 ft. deep, at refinery here, at $11,700. Owner will do excavt'g and backfilling; also furnish cement.

Colo., Denver—Municipal Water Works Dept., will replace conduit on 29th Ave., Lowell Blvd. to Ashland Ave., Sta., abt. 2½ mi., involving 7,000 ft. 36-in. c. i. pipe. Abt. $171,000. Work will be done by day labor.

Ill., Moline—Moline Heating & Constr. Co., award. contr. for constr. of water Main in 27th Ave., at $3,699; also sewer & water main in 18th Ave. at $2,163.

Ind., Wabash—J. F. Cole, South Bend, awarded contract by town council of Lafontaine for bldg. water works at $30,000.

Iowa, Lake City—Thorpe Bros., 209 Good Blk., Des Moines, awarded contract for $2,000-ft. wells, one street each of the following towns: Ames, Lake City and No. English.

Ia., Spirit Lake—Hammen-Kruse Constr. Co., Spencer, award. contr. for water works extension, at $52,763.

Kans., Lawrence—Pittsburgh-Des Moines Steel Co., Des Moines, award. contr. by Haskell Inst. for bldg. 40,000-gal. steel tank and tower, at $7,485.

Mass., Boston—G. H. Byrne, 160 Devonshire St., award. contr. for bldg. pipe delivery line, at $31,750. Wk. involves 300 ft. 12-in. c. i. pipe for land constr. and 3,400 ft. 12-in. submerged flex. pipe.

Mass., Boston—The C. & R. Constr. Co., will probably be award. contract for laying water pipes in Washington St., Perry to Wilkes Sts. High St., Congress to Federal St.; Federal St., Milton Pl. to Summer St., at $3,050.

Mass., Boston—Geo. M. Byrne, award. contract for laying water pipes on Long and Moon Islands and flex. jointed pipes in Boston Harbor from Moon to Long Islands, at $31,750.

Mich., Ecorse—T. C. Brooks & Son, W. Grand Blvd., Detroit, awarded contract for furnishing and installing 8,000 ft. water mains with hydrants, valves and 2 motor driven centrif. pumps, 500 gal. capy. per min., etc., $24,000; Pitt Constr. Co., Wyandotte, 500,000-gal. rein. conc. reservoir, $19,000; Pittsburgh-Des Moines Steel Co., 801 Curry Bldg., Pittsburgh, elevated steel tank with 150,000-gal. capy.

Mich., Niles—Geo. Haney Co., So. Bend, Ind., awarded contract for 500,000 gal. rein. conc. reservoir.

Minn., Blooming Prairie—Arsen Auto Co., award. contract to extend water mains of village to 6th St., at 65c per ft., about 2,200 ft. will be built.

Minn., Duluth—Geo. H. Lounsberry, 322 E. Superior St., award. contr. for concrete reservoir at $18,770.

Minn., Elk River—Phelps-Drake Co., Hibbing, Minn., award. contr. for water works system; McCarthy Well Co., Wabash and Eustic Sts., St. Paul, award. contract for 12-in. drilled well at $9,35 per ft.

Minn., Foley—Pastoret Constr. Co., 510 Lyceum Bldg., Duluth, Minn., award. contract for water works system, at $40,000.

Minn., Litchfield—E. Linhordt, Litchfield, awarded contract for bldg. 7,880 lin. ft. 8-in. and 2,235 ft. 10-in. water mains in various streets, at $13,086.

Minn., Walker—Woodrich Constr. Co., Metropolitan Life Bldg., Minneapolis, award. contract for extending water supply system for $25,558.

Mo., Marysville—Randall Constr. Co., Kans. City, award. contract for bldg. 2 reservoirs, rein. conc. coagulatory plant, rein. conc. storg. plant, twp 600 g. p. m. motor driven pumps and one 7,000 g. p. m. low serv. pump, at $35,500.

Mo., Weston.—C. P. Breen, Parkville, awarded contract for extending pipe line and bldg. well and concrete reservoir, at $13,400.

Neb., Papillion—Guy L. Horn, awarded general contract for sinking 2 deep wells in town of Kennard, at about $5,000.

N. J., Trenton—Harry E. Stahl, City, low bidder for furnishing and installing steam, electric and hydraulic apparatus in pumping station at Calhoun St., at $108,-961.

N. Y., Central Islip—A. J. Connolly, 100 S. 10th St., Newark, N. J., award. contract for additional water supply at No. Colony Power Plant, at $4,720.

N. Y., Rochester—M. H. Ripton, Livingston Bldg., award. contract for laying 36-in. water main across Genesee River on McLean Pl., at $21,003.

N. C., Williamston—H. L. McGhee Co., award. contract to install water and sewer systems; city will purchase all material; 2 centrif. pumps, 500 gals. per min., 250,-000-gal. rein. conc. reservoir; 75,000-gal. steel water tank on 100-ft. steel tower, 46-585 lin. ft. 2 to 10-in. water piping, etc.

N. D., Dickinson—C. L. Tillquist, award. general contract by Stark Co., for 2 wells at city water works.

N. D., Hettinger—Gedney & Murphy, 612 Globe Bldg., Minneapolis, award. contract for septic tank, at $52,400.

Okla., Altus—Maney Bros., 304 Empire Bldg., Okla., award. contr. for impvt. of water works system, at abt. $62,500.

O., Ashland—H. S. Hecker Co., Cleveland, award. contr. for 3,375 ft. 24-in. concrete pipe and 5,900 ft. 16-in. iron pipe, at $52,-908.

O., Port Clinton—The A. Q. Thatcher Constr. Co., Toledo, award. contr. for placing submarine water line across Portage River, at $3,000.

Pa., Osceola Mills—Pittsburgh Des Moines Steel Co., Curry Bldg., Pittsburgh awarded contract for constructing elevated steel tower in connection with water works system.

Pa., Philadelphia—David Doyle, low bidder for furnishing and installing complete at Queen Lane pumping station four turbo centrif. pumping units at $372,300.

Pa., Pittsburgh—D. T. Riffle, award. contr. for extension to Waverly Oil Works at 54th Street and Allegheny Valley Railroad at $100,000.

S. D., Iroquois—E. T. Sykes Co., 2317 Pleasant Ave., Minneapolis, Minn., awarded contr. for water works system. 26 hydrants required.

Wash., Seattle—G. Alfonzo, 6 N. W. and W. 88th St., award. contr. for laying 2,636 ft. 8-in. and 256 ft. 12-in. c. i. water mains in 12th Ave. N. E. et al, at $12,483.

Wyo., Greybull—Standard Plumbing Co., awarded contract for laying 3,000 ft. of water mains.

BRIDGES AND BUILDINGS

Ark., Searcy—J. S. Kelley, Judsonia, Ark., award. contract to construct brdgs. & culverts, at $107,814.

Ark., Stuttgart—Vincennes Bridge Co., Vincennes, Ind., awarded contr. for construction of bridges, at $46,475.

Cal., Merced—Treichel & Wilcock, award. contr. for constr. of rein. conc. bridge No. 70, at Athlone; also contr. for constr. of rein. conc. brdg. No. 44 at Atwater, at $2,534 and $1,960, respectively; C. J. Droesch, award. contr. for constructing rein. conc. brdg. over canal west of here, at $5,088.

Cal., Petaluma—J. Gildersleeve, award. contract by Marn Co. Bd. of Supvrs., for constr. of Pacheco bridge on State Hwy. betw. Novato and San Rafael, at $4,530.

Cal., San Jose—J. H. Miller, San Jose, award. contr. for constructing rein. conc. bridge on Alamrock Ave. near San Jose, at $10,993.

Cal., Santa Barbara—J. C. Lillis, Santa Barbara, award. contr. for constructing rein. conc. bridge over Sutton Slough in Carpinteria, at $2,554.

Cal., Yuba City—F. A. Holdener, Sacramento, award. contract for constr. of two bridges in Sutter Co.: Bridge on Coon Crk., at $7,529 and Macum Slough bridge at $3,409.

Colo., Denver—Monarch Engineering Co., award. contr. for 80-ft. steel bridge on Wind River Rd., Fremont Co., at $12,356; Levy Constr. Co., award. contr. for 89-ft. conc. bridge on Moorcroft-Carlisle road at $9,342.

Conn., Bristol—Cosmo Vacco, award. contract for constr. of conc. bridge on Main St., at $3,925.

Fla., Jacksonville—Bethlehem Steel Bridge Corp., Bethlehem, Pa., awarded contract to furnish and build the superstruct. of million dollar bridge over St. John's River from here to So. Jacksonville at $534,180; Missouri Valley Bridge & Iron Co., Leavenworth, Kans., contract for the foundations and approaches at $374,447. Bridge will be 2,100 ft. long, of steel and conc. fdns.

Ill., Belleville—A. P. Poirot, Belleville, awarded contract for construction of the Hankahammer bridge and the Keck culvert in Millstadt Twp., at $4,170.

Ill., Springfield—Amos Culberson, award. contr. for constr. of Keller Bridge, Johnson Twp., Christian Co., at $17,000.

Ill., Springfield—L. V. Chesrown, Olney, Ill., award. contr. for 4 rein. conc. bridges, at $5,058.

Ill., Springfield—A. O. McCoy, awarded contract for McVicker No. 1 brdg. Johnson Twp., Chsrian Co., at $3,273.

Ill., Springfield—J. M. Collignon & Son, award. contracts for the Judy and Ramsay bridges, Sugar Creek Twp., Clinton Co., at $3,240 and $635, respectively.

Ill., Springfield—Peter McCulley Constr. Co., Mackinaw, award. contr. by Div. of Hwys., for erection of bridge over Mackinaw river, Tazewell County, at $63,000.

Ill., Watseka—Continental Bridge Co., Peotone, Ill., award. contr. for one rein. conc. bridge, Iroquois Co., at $2,855.

Ill., Springfield—Joliet Bridge & Constr. Co., award. contr. for Cole bridge, Burton Twp., McHenry Co., at $8,750; Armor, Sauerwine, Sanders and Corbin brdgs., Polk Twp., to W. R. Cole, at $13,859; Loveless brdg. S. Otter Twp., to J. F. Miller at $640; Edminston, Gosn. No. 1, No. 2 and Haven brdgs., Barr Twp., to Bert Woolfolk, at $3,398; Cline brdg., Scottville Twp., to Bert Woolfolk at $852; Kahl brdg., Shipman Twp., to Herrick Constr. Co., at $2,367; Chiles & Rhodes brdgs., Polk Twp., to Herrick Constr. Co., at $1,867. All bridges located in Macoupin Co.

Ill., Tuscola—James & Shinn Co., Mattoon, award. contract by Moult and Douglas Cos., for constr. of 3 new bridges near Arthur, at $9,370. One of the bridges will be of conc. with 32 ft. span; two will be of steel with spans of 40 ft. each and conc. abutms.

Ind., Ft. Wayne—Herman Tapp Constr. Co., award. contract by County Commrs. to construct new bridge at Swinney Park, to span St. Mary's river, at $16,600. Contract providse for removal of old State street bridge, which is now being replaced with new conc. struct., to Swinney Pk. and bldg. the same across the river at that point.

Ia., Davenport—Walsh Constr. Co., will build two bridges; one for the New York State Barge Comn., near Schnectady and the other at Scranton, Pa., at total cost of $700,000.

Kans., El Dorado—Maxwell Constr. Co., Columbia, Kans. awarded contracts for construction of following bridges: Ramsey, at $8,981; Dixon brdg. $13,943; Ramp brdg., $2,750 and Elbing brdg., $2,635; Campbell Bros., Kans. City, Mo., contract for Carter bridge, at $15,360; Wilday and Reager, Augusta, contracts for Benton brdgs. Nos. 9 and 10, at $11,564 and $9,295, respectively.

Kans., Wichita—Missouri Valley Bridge & Iron Co., award. contract for constr. of bridges over Arkansas river at water works island and just west of term. ground at Waco and Douglas Sts., for Interurban terminal bldg. to be erected soon.

Mich., Boyne City—Monroe & Hughes, E. Jordan, award. contract for construction of bridge over Boyne river, Evangeline Twp., at $18,500.

Mich., Lansing—A. B. Morrison, So. Military St., Port Huron, award. contract for bldg. 316 ft. steel bridge, 34 ft. wide with 86 ft. steel brdg. 34 ft. wide, with 86-ft. fixed spans and 1 basc. span, involving 1,960 cu. yds. conc., 259 tons steel, etc., at about $160,000.

Minn., Blue Earth—Babcock Bros., Winnebago, Minn., award. contr. for bridge W33044. r. c. culvts., in Faribault Co., at $1,065; Williams and Jacobson, Winnebago, ward. contract for bridge 2322-C, at $3,100.

Minn., Crookston—Abel Ness, Crookston, awarded contract for conc. brdg. Hammond Twp., at $1,650.

Minn., Fergus Falls—Iowa Bridge Co., 317 McKnight Bldg., Minneapolis, award. general contract for one conc. brdg. over Red River of North, at Court St., and one conc. brdg. over Red River of North at Union Ave., at $99,150.

Minn., Hibbing—David Graham, local, award. general contract for 14 bridges, at $30,000.

Minn., Minneapolis—Wm. S. Hewitt Co., award. contract for Lyndale Ave. bridge at $193,793; Illinois Bridge Co., award. contract for bridge over Long Meadows, at $114,940.

Mont., Great Falls—Porter Bros., Spokane, awarded contract for work on two rein.-conc. bridges ocrass Missouri River here. Bridge at 10th St., will be 1,130 ft. long, exclusive of approaches, and will have spans; is 36 ft. wide and clears high water mark by 18 ft.; The First Ave., N. brdg. is 965 ft. long exclusive of approaches and 58 ft. wide; 7 spans. Contract price is $57,840.

Mont., Melrose—J. R. Silver, Jr., Butte, awarded contr. by Silver Bow Co. for constr. of steel bridge over Beaverhead river, at $16,000.

Neb., Aurora—Western Bridge Constr. Co., 648 Bee Bldg., Omaha, Neb., awarded contract for state aid bridge over Platte river so. of Central City, and second state aid bridge over Platte river from Hamilton Co., north, at $83,990.

Neb., Central City—Western Bridge & Constr. Co., Omaha, awarded contr. for constructing state aid conc. brdg., over Platte River due south of Central City, at approximately $100,000. Contract provides for spanning 800 ft. water space and balance to be filled.

Neb., Gering—Allied Contractors, Inc., Omaha, awarded contract for constr. of four bridges as follows: Gering-Scottsbluff brdg., $75,600; Minatare, $57,000; Morrill, $57,900 and Henry bridge, $65,925.

N. J., Atlantic City—Henry Krause, Mays Landing, N. J., awarded contr. for constr. and completion of highway bridge spanning main outlet of Weymouth Dam on road leading from Mays Landing to Da Costa, at $18,372.

N. J., Newark—Jno. W. Heller, So. Orange, award. contract for extending the Chancellor Ave. bridge in Irvington, at $18,128; Jas. Cardell, Montclair, award. contr. for rebldg. Dutch Lane bridge in Caldwell at $14,900; Michael Loprete, award. contr. for bldg. 3 bridges in Washington Park, S. Orange, at $8,790; Chas. J. Romano, Montclair, award. contract to construct brdg. in Park Ave., Verona.

N. Y., Watertown—Walsh Constr. Co., Herald Bldg., Syracuse, award. contract for rein. conc. bridge, 2 spans, 75 ft. each, at $53,892.

O., Lima—Z. Blodgett, Lima, award. contract for constr. of Metcalf St. bridge, at $33,958.

O., Painesville—King Bridge Co., Clevelanl, award. contr. for high el viaduct at Willoughby at $231,000; approaches let to Walsh Constr. Co., Cleveland, at $17,000.

O., Willoughby—King Bridge Co., E. 60th St., Cleveland, award. contr. for bldg. rein. conc. viaduct over Chagrin River and Valley here, at $242,237; Walsh Constr. Co., Citizens Bldg., Cleveland, contr. for approaches at $17,090.

Okla., Clermont—Missouri Valley Bridge & Iron Co., award. contr. by Bd. County Commrs., for constr. of bridge over the Verdigris river at Sageeyah, at $34,000; Inola Bridge, awarded to Sullivan and Beecher of Wagon, at $30,000.

Okla., Enid—Following contracts for brdg. constr. let by County Commrs. of Garfield County: Hoffman & Sons, Douglas, 9 bridges; Hyde Constr. Co., Enid, 6 brdgs.; C. G. Landon, Oklahoma City, 9 bridges; Murphy, Hillsdale, one brdg. Total cost, $50,000.

Pa., Smethport—T. F. Hungiville, awarded contract for constr. of bridge on East Street, connecting this Boro, and E. Smethport, at $16,300.

R. I., Barrington—R. Stoddard, Chelsea, awarded contract by State Bd. of Pub. Rds., Providence, for bldg. state bridges Nos. 72, 106, 108, 122, at $28,660.

Tenn., Chattanooga—M. C. Monday, Knoxville, Tenn., awarded contract for piers and masonry work on brdg. across

Tenn. River near Boyce; American Bridge Co., 30 Church St., New York, contr. for superstruct. Bridge will be of rein. conc., 310-ft. span and cost $1,000,000.

Tex., Seguin—A. D. McClain & Co., Houston, award. contract for bldg. 3 bridges on Hwy. No. 3, abt. $22,500.

Tex., Texarkana—Vincennes Bridge Co., Vincennes, Ind., awarded contr. for constr. of bridge over Sulphur river at Fort Lynn, 20 miles so. of here, at $33,450. Bridge will be of steel with conc. approaches and have a total length of a little more than 300 ft.

Wash., Chelan Sta., (Chelan, P. O.)—McRae Bros., American Bk. Bldg., Seattle, awarded contract by Wenatchee-Beebe Orchard Co. for bldg. piers for 630 ft. span bridge with 650 ft. approach. Work on superstruct. will be done by day labor. Total cost $75,000.

Wash., Olympia—Union Bridge Co. ward. contract for constr. of brdg. over Yakima River betw. Kennewick and Richland, Benton Co., at $45,000.

Wash., Pasco—J. R. Wood, Central Bldg., Seattle, awarded contract for constr. of steel bridge 1,556 ft. long in 6 parts at total cost of $207,000.

PROSPECTIVE WORK

ROADS AND STREETS

Ala., Montgomery—Project providing for impvt. of 4-mile stretch of rd. extending from Camp McClellan to Jacksonville with waterbound macadam and bitum. surf., to be constructed with federal aid, approved by Secy. of Agriculture. Est. cost of construction, $53,000.

Cal., Bakersfield—40 miles 6-in. concrete pavements, 15 to 16 ft. wide will be laid under Midway-Fellows-McKittrick District. Paul E. Kressley, Newport Beach, appointed engineer to make surveys and have charge of the work.

Cal., Fresno—Bd. Supvrs., Fresno Co., has applied to U. S. Bureau of Good Rds., for funds to grade, gravel, oil and drain roads as follows: $30,000 for Trimmer Springs Rd.; $80,000 for Tool House Rd.; $60,000 for Sand Creek Rd.; $30,000 for Millwood and Sand Crk. cutoff and $100,000 for Auberry-Huntington Lake Road. D. M. Barnwell, Clk.

Cal., Long Beach—City Commission has ordered concrete paving for E. 4th Street, Molino to Termino Aves.; also sewers in the section betw. Loma and Termino Aves. $60,000. Fred Hoffman, City Engr.

Cal., San Diego—City Engineer has completed plans and will submit them to City Council for paving Rosecrans St., Lytton St. to Government reservation at Point Loma; abt. 4 miles in length. Est. cost, $80,000. Government will continue the paving within reservation at cost of abt. $76,000.

Ga., Atlanta—Owners and residents of property on Edgewood Ave., North Blvd. to Spruce Sts., have requested County Pub. Wks. Comm. to improve street by paving.

Ga., Macon—Commrs. of Rds. & Revenues have decided to begin work of paving National Hwy., Tifton to Co. Cook line, south, as soon as State Hwy. Comm. approves prelim. report made by Engr. Still. Width of road will be 15 ft. and material used will be conc., ranging in depth from 7 to 5 ins.

Ga., Savannah—First task to which the Automobile Club, recently formed, will devote its energies will be the bldg. of the Savannah - Brunswick - Jacksonville and Waycross Hwys.

Idaho, Boise—Project estimates on two no. Idaho roads—links of the North and South Hwys.—made out by the state bureau of hwys. and will be forwarded to Washington, D. C. for consideration of federal officials. Est. cost, $602,000. One of the links will be from no. end of Lewiston grade, at Lewistown to Moscow—22.4 miles long and will cost $307,000; crushed rock surfacing; Harrison and Wolf Lodge will be connected by other proposed link—approx. 30 miles through Lakeside Hwy. dist., Keetenai Co. Est. cost, $295,000.

Idaho, Caldwell—Farmers in Deer Flat and other farming sects. so. of Caldwell are planning to organize local hwy. dist. to improve roads in their section. One proposition they are considering is that of making a paved rd., reaching from Caldwell southward in a horseshoe shape and returning to the city from a different angle. Road would be approx. 30 miles long. Eastern sect. of Nampa has already organized a hwy. dist., and has voted $500,000 for good roads. Ests. now being gathered as to cost of paved road.

Idaho, Lewiston—T. W. Carrick, Engr., for Cramont Hwy. Dist. will begin survey of road into Deer Creek. mines district. Rd. will be betw. 12 and 13 miles in length.

Ill., Alton—St. Clair Co. Supvrs. have voted funds for Fed. and State aid road to connect Granite City and East. St. Louis. Rd. will be of concrete and extend from 9th St., in E. St. Louis almost directly no. to Granite City.

Ill., Aurora—Petitions for paving two streets on Pigeon Hill, in circulation, and will be ready for presentation to Bd. Pub. Wks. in near future. Streets are Forest Ave., Aurora Ave. to Sheridan St.; Mountain street, Ill. Ave. brdg. to High Street. Petition also being circulated for paving Talma Street. Effort will be made by city to have property owners sign up for paving all the way thru to Union St.

Ill., Bloomington—City contemplates improvement of Towanda Ave., to extend from E. Monroe St. to city limits where it will connect with the conc. state aid hwy.

Ill., Bloomington—Ords. passed by Council providing for pavement on W. Locust St., betw. Lumber and Western Ave.; and pavement on Elm and Bell Sts., betw. Gridley and Bunn Sts. Est. cost of two impvts. $7,223 and $20,683, respectively.

Ill., Chicago—Drainage Board has decided to construct concrete road from Lawrence Ave., in City to Sheridan Road in Wilmette. Road for the larger part of the 8 miles will be along east bank of canal; will be 36 ft. wide, with a shoulder of 4-ft. of macadam on each side, giving rdway total width of 44 ft. It will probably cost abt. $500,000.

Ill., Herrin—City will pave in District No. 4. Engineer's est. calls for 19,995 sq. yds. concrete paving. Total est. cost, $74,625. Dist. includes So. 13th and 14th streets.

Ill., Lincoln—A. J. Hahn, Albany, N. Y., and B. G. Britton, Keokuk, Ia., have begun work of surveying new Logan county state aid roads that are to be started this fall.

Ill., Quincy—City Contemplates paving Third St., Oak to Vermont, Broadway, Front to Third; Vermont, Front to Third; Hampshire, Front to Third, and Front, Broadway to Hampshire; Oak, Second to Fourth; Fourth, Oak to Vermont; Vermont, Third to Fifth and Broadway, Third to Fourth.

Ill., Rockford—Petition will be made at once to Thos. G. Levings, Hwy. Commr. to pave Blackhawk Blvd., which is to be opened from Kishwaukee street west to Blackhawk park, Blvk. will be 99 ft. wide.

Ill., Springfield—Report current that state hwy. authorities are considering the paving of Grant Hwy.—Chicago to Freeport, via Rockford. If favorable action is taken, bids will be asked for this fall and contracts let in order that work of paving might being early in spring. Farmers along Rockford-Durand Road desire that highway be improved as it is impassable in the winter.

Ind., Jasper—Dubois Co. has appropriated $200,000 for constr. of stone roads in county under county unit plan.

Ind., Lafayette—Macon County voted in favor of bond issue for road construction. Proposed road will run from Westmoreland to Lafayette, joining the Red Boiling Springs Road at Clay Co. line.

Ind., New Albany—Floyd Co. Council will consider petitions asking for reconstr. of the River Rd. in Franklin Twp., New Albany and Jasper Rd. in Georgetown Twp. and Scottsville Rd., Greenville Twp.

Ia., Clinton—$1,800,00 road bonds voted by Clinton Co. for purpose of paving primary roads.

Ia., Davenport—Ord. introduced calling for paving of 18th Ave.—38th to 44th Sts., with asph. macadam. Est. Cost of impvt. $38,159.

Ia., Hampton—First rd. dist. in this county to be improved under new road law is hwy. betw. Hampton and Dows—abt. 17 miles. It is proposed to surface with gravel.

Kans., Garden City—Several streets will be paved here and water mains laid. Est. cost, $60,000.

Kans., Great Bend—Barton Co. Commrs. have authorized grading county road from Ellinwood east to Rice—Burton county line.

Kans., Independence—Petition filed with County Commrs. for hard surface road connecting with W. Laurel street 2 miles west of city, then south to Caney.

Ky., Greenville—Fiscal Court has voted an appropriation of $66,000 to be used for constr. of Fed. Hwy. from Owensboro to Dawson Springs, by way of Calhoun, Sacramento, Bremen, So. Carrollton, Central City, Greenville, Depoy and Nortonville. Muhlenberg county's part of the cost of this road is $219,600.

Ky., Harrodsburg—Resolution passed to apply for Fed. and State aid on highway from here to Shakertown. Cost of reconstr. $75,000.

Ky., Louisville — Prominent citizens of Oldham county have raised $100,000 toward fund of $160,000 which will be given by county to help construct proposed Federal hwy.—Louisville to Cincinnati.

La., New Orleans—Cost of resurfacing St. Charles street— Lee Circle to Canal—will be $84,583, according to figures submitted to Comn. Council by City Engr. T. L. Willis. Distance is about 3,490 ft. with estimated surf. of 16,172 sq. yds.

La., Oberlin—$425,000 Allen Parish road bonds sold. This means the early completion of Pelican Hwy. thru Allen, as well as constr. of other hard-surfaced roads in the parish.

La., Sicily Island—Catahoula Parish has voted favorably on issuance of $800,000 road impvt. bonds.

Mass., Springfield—Est. for proposed impvts. and changes in State Hwy. at Frog Home, 3 miles east of here, has been submitted. Work will cost $23,000. Steps will be taken to petition Legislature for an appropriation.

Mich., Alma—City Comn. has voted in favor of paving Bridge St., Michigan Ave., as far south as no. limits of Republic factory. Improvement will be of concrete.

Mich., Holland—Austin Harrington, Ottawa County Rd. Commr. announced that a 16 ft. concrete road is to be constructed along Lake Michigan, beginning at Ottawa Beach to Lakewood farm, thence to Tenn. Beach, Alpena Beach and up to Port Sheldon about 10 miles north.

Mich., Grand Rapids—Resolutions adopted by City Commission: Grading and paving Terrace Ave. betw. Griggs and Burton Sts., with rein. conc.; impvt. of Temple St., with rein. conc. betw. Eastern and Kalamazoo Aves.; sewer in Temple St.,—betw. Eastern and Kalamazoo also Eastern Ave.—Adams to Temple. Commisison also asked for estimate of cost of resurfacing Crescent street with sheet asph. betw. Bostwick and Union Ave.

Mich., Hastings—Petitions filed with Co. Rd. Commrs. for bldg. 10 mi. of state reward road under Covert Act—Nashville no. 10 mi. to sect. corner of Sects. 1, 2, 10 and 11 in Woodland.

Mich., Marquette—State Hwy. Comn. has plan to link up existing trunk lines by constr. of 90 miles of trunk line hwy. in Upper Michigan. Authorized by state legislature. Lower Michigan is apportioned the remaining 410 miles of the 500 miles alloted to the state.

Miss., Vicksburg—City will pave 50 blocks of streets. J. J. Hayes, Mayor.

Minn., Duluth—$7,500,000 bonds voted for good roads by St. Louis County.

Minn., Minneapolis—Plans being considered for 50-ft. widening of Lake St.,—Lake Calhoun to bridge over Miss. river—at est. cost of $2.500.000.

Minn., St. Cloud—Several additional miles of paving here will be considered by the City Commission in near future.

Minn., Thief River Falls—Plans and specfs. approved for improvement work aggregating about $300,000. Work will include paving, sewer and water main construction storm sewers and white way. Plans prepared by Bradley Engineering Service of St. Cloud.

Mo., Jefferson City—State Hwy. Bd. has approved 14 road projects, embracing 18 mile road; 8-mile brk., and balance gravel, conc. and bitum. macadam. $3,026,231.17.

Mo., Mexico—Audrain County Commrs. will call election to vote on $1,000,000 bonds for 200 miles hard-surfaced roads.

Mo., Poplar Bluffs—$95.000 good road bonds voted in Castor Twp., Stoddard County.

Mo., St. Louis—Movement launched at Alton for hard road to connect Alton with Calhoun Co., Illinois. Alton Bd. of Trade in favor of bond issue of $1.000,000, backed by Alton and Madison county for constr. of the portion of road within boundaries of Madison Co.

Mo., St. Louis—Work will soon begin on St. Louis county roads as a result of the exchange of $360.000 in county road bonds for a like amt. of refunding bonds. Transaction gives county $520.000 for immediate expenditure upon roads. Principal

work will be upon the four state hwys. Gravois, St. Charles, Manchester and Lemay roads.

Mo., Springfield—45 miles of new roads are to be constructed in Ozark Co., at cost of $2,000 a mile. Roads will be constructed of natural soil and gravel; 20 miles of rds. Howell Co., will cost $4,000 a mile, and will be built of gravel and rock with surf, 16 ft. wide. $500,000 bond issue recently voted in this county which will cover cost of this and other roads. H. P. Mobberly, Div. Engr. of State Hwy. Comn., will inspect proposed 14 mile hwy., in Polk County which will extend from Greene County line to one mile this side of Bolivar. If route is approved by him work will begin immediately. Rd. will cost abt. $4,200 a mile.

Mo., Windsor—$50,000 good road bonds voted in Windsor Twp.

Mont., Anaconda—It is proposed to construct 10 miles of cement hwys. 18 ft. wide at cost of $15,000 per mile. Co Commrs. have requested State Hwy. Comn. to approve the plans for a cement hwy.

Mont., Glendive — $200,000 road bonds voted by Dawson County.

Neb., Carroll—Village will construct paving. Quantities: 3-in. vit. fibre brk. with conc. base, 12,420 sq. yds. paving, brk. 6-in. base, 12,420 sq. yds. paving, brk. 6-in. base, 2 course conc., 3460 yds. excav., 85c yd. approx., 3,895 lin. ft. curb, 87c per ft.; 250 ft. 10-in. c. i. pipe, $14; 8 catchbasins $25 each; 4 manholes $30 each. G. A. Jones, Clk.

Neb., Gibbon—Town will pave 19 blocks of streets in Gibbon.

N. J., Pitman—Demand for immediate impvt. of sect. of the Glassboro-Westville pike, betw. eastern part of Pitman and Glassboro, will be made at meeting of Gloucester Co. Bd. of Freeholders.

N. Y., Johnson City—Plans completed for widening Mildred street—Farr Ave. east to the Weir tract where street is now 40 ft. wide.

N. Y. Brooklyn—Plans for Jamaica Bay Blvd. ready and will be submitted to Bd. of Estimate. Resolution for constr. provides for regulating and grading the blvd. on the Rockaway peninsula from a property line 1,395 ft. so. of Sheridan Ave., to northerly U. S. pier and bulkhead line of Jamaica Bay, and for constructing bulkheads, retaining walls, ditches, drains, culvts., guard rails and incidental work to the improvement of the blvd. across the bay from northerly U. S. pier and bulkhead line of Jamaica Bay, located abt. 100 ft. no. of Beach Channel Drive in Boro. of Queens.

N. Y., Schenectady—The half-mile connecting rdway within village of Scotia, will be constructed at earliest possible moment. Bd. of Supvrs. voted to appropriate $4,270 as county's share of the expense.

O., Bellaire—Council has passed necessary legislation for paving of Spruce and Vine streets on Rose Hill. It is expected the work will begin soon.

O., Hamilton—Ord. passed to proceed with impvt. of Huston St.,—Ross Ave. to Franklin Street: Franklin St.—B to C Sts., by paving roadways, constructing curbing, guttering, sanitary sewers and house connections. Karl E. Krieger, Clk.

O., Lisbon—Resolution adopted to proceed with impvt. of N. Market St., Jerome street northward to Village limits by paving with concrete.

O., Newark—Citizens of Eton and Harrison Twps., together with twps. no. of Johnstown, have petitioned the state hwy. dept. for an inter-county hwy., from Fairfield county line thru Etna to Pataskala and no. to intersect. at Hazelton cors. of Newark-Johnstown Rd.

O., Toledo—Wood County road bonds to amt. of $45,000 sold. Sand Ridge road will now be improved. This is located two miles southwest of Bowling Green.

O., Zanesville—Ord. passed to proceed with impvt. of Thurman St.—Maple Ave. to Euclid Ave.,—by grading, paving and curbing; also State street—Lee to Blue Ave., and Blue Ave., State street to McIntire Ave. C. W. Simpson, Clk.

Okla., Guthrie—Creek County has voted a million dollar good road bonds and work of improving roads will start at once.

Okla., Idabel—City considering paving residence and business dists. as soon as work on system of sanitary sewers is well under way. Johnson & Benham, Consit. Engrs., 8th Flr., Firestone Bldg., Kans. City, Mo.

Okla., Madill—Board of Commrs. have instructed Engrs., Johnson and Benham of Kansas City, Mo., to prepare final plans and specfs. for 50 blocks of reinf. conc. paving in business and residence districts. Expect to ask bids in near future. Approx. cost of work, $275,000.

Okla., Poteau—City contemplates paving 60 blocks of streets.

Okla., Sapulpa—Creek Co. Commrs. considering impvt. of 130 miles of clay-surface roads. $1,460,000 available. M. E. Binckley, Engr.

Ore., The Dalles—Plans and specfs. for continuance of east link of Columbia River hwy., joining it with The Dalles, accepted by Council and bonds for bldg. of Seufert Rd., as well as the $12,000 macadam bonds have been placed on the market. Plans call for constr. of concrete retaining wall. City Engr. authorized to complete plans for improvement in west end of town and the hard surfacing of Eighth street.

Ore., Pendleton—County Court, Umatilla Co., has set aside funds to be expended upon 3 hwys. in county; one leading from Freewater to Umapine, abt. 6 miles, $35,000; one from Havana to Helix, 10 mi., $90,000 and the other, Pendleton to Pilot Rock, abt. 11 miles, $70,000. These are three of the most important hwys. of the county and will be feeders for the main highways now under constr.

Pa., Greensburg—3 new and important roads have been approved for Westmoreland Co. One extends from W. Newton to Sewickley Twp.; one from Mt. Pleasant to United. a dist. of 4 miles, while the third is in Rostraver Typ.

Pa., West. Pittston—Election in November to vote on $40,000 bonds for repairs on streets, constr. of sewers; also purch. of motor driven fire apparatus.

R. I., Providence—Resolutions appropriating $182,000 for street repairing and curbing passed by Common Council and Bd of Aldermen.

R. I., Providence—Town of Westerly voted to expend $30,000 on hwy. from Westerly to Bradford; $6,000 on hwy. betw. Westerly and White Rock and $26,000 on hwys. at Pleasant View; total $60,000.

R. I., Woonsocket—Bd. of Alderman have

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referred to Finance Comm. resolution providing $67,000 for paving and curbing Cumberland St., Cass Ave. to Cumberland hill road, and have accepted report of Commrs. on the relaying, straightening and widening of this thoroughfare.

S. C., Chester—$140,000 bonds voted for street paving.

So. Car., Winnsboro—$400,000 bonds voted for purpose of establishing county-wide system of roads.

Tenn., Decatur—Ords., providing for paving Church, R. R., and Vine Sts., passed by Decatur council at meeting. R. E. Meade, City Engr.

Tenn., Camden—Benton County voted in favor of isuance of $200,000 rd. bonds.

Tenn., Linden—Survey of route of Hwy. No. 1 thru Perry Co. now being made under supervision of Henry Buck, Chf. Engr. Route of hwy. will cross county from east to west for a dist. of approx. 25 miles. County has already appropriated funds for bldg. road which will be supplemented by state and national governments.

Tex., Brownsville—Haywood Co. Commrs. considering completing 41 mi. Memphis to Bristol Hwy. thru Haywood Co. $200,000 bonds voted; State & Fed. aid., $400,000.

Tex., Dallas—$6,500,000 bonds voted by Dallas County in favor of good roads.

Tex., Dallas—County Commrs., by special order, have set aside sum of $129,982 of Tarrant Co. good roads funds derived from bond issue for constr. of 5 8-10 miles of rdway on Dallas—Ft. Worth pike.

Tex., Lockhart—Ord. passed by City Comn. that will mean the rebldg. of most of the principal streets of city.

Tex., Palo Pinto—Palo Pinto Co., will vote on $1,500,000 road bonds.

Tex., Pearsall—City Council has authorized City Treas. to take prelim. steps toward paving of streets of city. Civ. Engrs. at work securing data as to cost of impvts.

Tex., Stephenville—Plans being discussed and will likely materialize soon for constr. of toll road—Stephenville to Desdemona. It is estimated that $250,000 or $360,000 will build and maintain the road.

Tex., Terrell—Arrangements being made to pave W. Moore Ave., in City—about 8 blocks.

Tex., Uvalde—$200,000 bonds voted for good roads in Sabina and Utopia precincts of Uvalde County, which gives this county $450,000 for road improvements.

Va., Richmond—Bd. of Aldermen adopted resolution authorizing finance committee to borrow $100,000 for impvt. of Chamberlayne Ave., paving of Fourth St., in So. Richmond and to provide equipt. for school.

Wn., Leavenworth—At meeting of County Good Rds. Comm. it was decided to adopt road bldg. program as follows: Conc. rd., bet. Wenatchee and Leavenworth (abt. 20 mi.), est. cost $597,000, of which $300,000 will be paid out of the bond issue, to which must be added $70,000 for Cashmere bridge and $10,000 for Peshantin bridge, making approx. cost of this road, $800,000. Recommendation made that elec. be called, bonds issued and sold at earliest possible date.

Wash., Seattle—Improvement of Westlake Ave., N.—Valley D. to 4th Ave., N. by paving additional rdway, is provided for in bill introduced at council meeting. Bill provides for an appropriation of $64,000 toward the improvement.

W. Va., Wheeling—Tentative plans for bond issue of $300,000 for repaving principal streets of Bellaire, have been made by city officials and members of council. Proposed impvt. includes approx. 70,000 sq. lds. and embraces principal streets of city.

Wis., Racine—At special elec., Racine County voted in favor of $2,350,000 bonds for good roads. Harry Bassinger, Co. Aud.

SEWERAGE AND SEWAGE TREATMENT

Ala., Gadsden—City considering sewer extension. Est. cost $88,500. Ernest Smith, City Engr.

Ark., Osceola—Council has pased Ords. so that present sewer system will be rebuilt and new system constructed. Sewer Commrs. will have the work in charge and it is estimated the impvt. will cost about $20,000.

Cal., Los Angeles—Council has decided that vitr. clay pipe will be used in constructing sewers in the Gulf Avenue sewer district at Wilmington.

Cal., Riverside—City Engr. Alb. Braunschweigre has prep. plans for new outfall sewer, 16, 18 and 20 in. in diam., to replace present 8-in. outfall sewer in Jackson street serving Arlington. City Atty. instructed to prepare resolution of intention for the work.

Idaho, Rexbury—City Council has decided to proceed with plans for installing sewer system and additional fire fighting apparatsu. Huddleson & Fiero, Engrs., Salt Lake City, retained for engineering work.

Ill., Carlinville—Board of Local Impvts. instructed to go ahead with Second South St. sanitary sewer, which will branch from sanitary sewer system No. 1 at intersect of Mayo and Charles streets and run east to the city limits; also install small sewer at west end of First North St. Town also contemplates constr. of Arnett and Murphy Addn., sanitary sewer.

Ill., Rockford—City contemplates bldg. sewers in sections of Loomis and Buchanan streets. Est. cost $2,000.

Ind., Connersville—Council has ordered City Engr. to draw up plan for sewer up Third Street hill.

Ind., Corydon—City contemplates calling election to vote on question of installing sewerage system.

Ind., Evansville—Bd. of Public Works has ordered constr. of three new sewers.

Ind., Ft. Wayne—City Engr. Randall instructed to prepare plans for storm water sewer drain from intersect. of Beaver Ave. and Oakdale Dr., to alley so. of Oakdale to Rudisill Blvd., and from blvd. to St. Mary's River. Resolutions also passed for sewers in various other streets and avenues.

Ind., Greenfield—Bids to be received in near future for constr. of the Meek Street sanitary sewer. Specfs. on file office of City Clk., or Chas. Boone, City Engr.

Ia., Dubuque—City considering constr. of sewers on Queen St. and Winsor Ave.,—Pfotzer St. to Henry; Henry to alley bet. Winsor and Queen; 430 lin. ft. 8-in. tule pipe, 3 manholes. Jno. Stuber, City Rec.

Ia., Muscatine—Council will construct deep sewer from Sycamore Street west on 2nd Street about 550 ft. Will probably be built this Fall. Jas. H. Sheldon, City Engr.

Ia., Kanawha—Ord. passed by Council to install sewerage system in town. Plans include disposal plant, main sewer and laterals.

Ia., Wall Lake—Town Council has adopted

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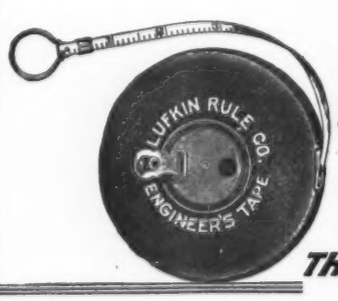

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resolution of necessity for establishment of sewer dist, within town and constr. of system of sewers and disp. plant.

Kans., Dodge City—18 blocks of sewer comprise program of extension of present system being prepared by city engineering department. Part of the work has already been approved by the state sanitary engineer.

Kans., Hanover—Resolution passed to build system of sanitary sewers and outfall sewers in accord. with plans now on file with City Clk.

Ky., Paducah—City solicitor instructed to bring in Ord. for floating of $250,000 worth of bonds for new sanitary sewer for city. If citizens vote in favor of system a 36-in. pipe will be placed instead of 30-in. as at first proposed; also new pipes will be laid in Mechanicsburg in southern part of town and in western sections of city.

Md., St. Michaels—Board of Commrs. considering constr. of sewer sys., disposal plant. $35,000. Levin J. Houston, Jr. Engr., Fredericksburg, Va.

Md., Westminster—Town considering bldg. sewer system. $250,000.

Mass., Lowell—An order to borrow $10,000 for constr. of sewers introduced by Commr. Murphy.

Mass., New Bedford—$18,050 will be expended for sewers in a number of streets. List of new sewers ordered and est. cost of each is as follows: Frank Street, $1,200; sect. of Wood Street, $4,000; sect. of Avon Street, $800; sect. of Plymouth Street, $3,000; Carroll Street, $3,000; Potter Street, $1,000; Arlington Street, $750; Grove Street, $1,300; Jenkins Street, $3,000.

Mich., Detroit—W. B. Stevenson, Fargo, wil prepare plans for storm sewers. E. J. Bestick, City Clk.

Minn., Adrian—Resolutions passed by Council to adopt sanitary sewer system in certain streets. Lateral sewers Nos. 1 to 8, inclusive, in district No. 1; also general sewer and disposal plant including septic tank and sludge bed. Druar & Smith, Engrs., 513 Globe Bldg., St. Paul. Plans approved by State Bd. of Health. Jos. Cowin, Pres. Village Council; Henry A. Lewis, Village Clk.

Minn., Luverne—$24,000 bonds voted by City for sewer construction. Jno. Bauer, Village Clk.

Minn., Madelia—City considering constr. of sewer on Cross Street—Miller Street to Hartshorn Street. W. W. Cole, Village Clk.

Minn., Milaca—City considering extension for sewer No. 3, sewerage dist. No. 1. Engr. Jas. D. Gray, D. S. Phillips, Pres. Village Council.

Minn., Minneapolis—Plans for new Minnehaha sewer now under way and will probably necessitate issuance of $500,000 worth of sewer bonds.

Minn., Moorhead—City considering sewer constr. on Front St.,—9th to 14th Streets. R. G. Price, City Clk.

Mont., Park City—City considering sewer construction. Est. cost $20,000. Engr. Parker Hastings, Billings. Chamber of Com. interested.

Neb., Alliance—Ord. passed by Council providing for constr. of sanitary sewers in Sewer Dist. No. 38. Ad D. Rogers, Mayor; Grace H. Kennedy, City Clk.

Neb., Bayard—Resolution adopted by Council to lay 20,353 ft. sewers in District No. 1. O. J. Lathrop, City Clk.

Neb., Omaha—City will provide sanitary sewer system for East Omaha. City Engineer's office will start immediately the preliminary surveying.

Neb., Scotts Bluff—Sewer District No. 14 created by Council. Est. cost of district, $4,295.

Neb., Wymore—City will sell two parks; funds to be used for constructing sewer system. Est. cost $50,000.

N. C., Enfield—$85,000 bonds voted by City for sewer and water systems.

S. C., Bamberg—G. D. Ryan, Engr., will survey and estimate cost of sewer system for city.

N. D., Minot—Minot Rotary Club has decided to put over the bond issue of $285,000 for constr. of a sewerage disposal plant.

O., Akron—Ord. passed to proceed with impvt. of Alfaretta Ave.—Howard to Carpenter Sts.; Carlyle St.—end of present sewer to Alfaretta Ave.; Aberdeen St.,—end of present sewer to Alfaretta Ave.; Carpenter St.—Uhler Ave. to Ruth Ave.; Ruth Ave.—Carpenter to Wall St., by constructing sewers and laterals therein. H. N. Seiler, Clk.

O., Akron—Plans for construction of the Willow Run sewer will be completed and work started before Fall.

O., Coshocton—Resolution adopted by Council to improve Orange St.—Cambridge to east end of Orange Street, by constructing sanitary sewer therein. O. S. Bowen, Clk.

O., Elyria—Resolution adopted authorizing constr. of sanitary sewer on East Ave. —Fourth Street to Middle Ave.

O., Georgetown—City contemplates bldg. complete sewer system and water works plant. Petitions being circulated and present indication are that majority of citizens are in favor of bond issue.

O., Hamilton—Ords. passed to construct sanitary sewers and house connections with vitr. sewer pipe, together with appurts., in sect. of Symmes Ave., Dixie Hwy., Hoover Ave., Clinton, Van Hook Ave., Tiffin Ave., and several other thoroughfares. L. J. Zilion, Pres. of Council; Karl E. Krieger, Clk.

O., Hamilton—Resolution passed to construct sanitary sewers and house connections where necessary in what is known as part of Lindenwald Sanitary Sewer Dist. No. 1. Karl E. Krieger, Clk.

O., Hamilton—State Bd. of Health has approved plans for sewer system. This assures sanitary sewer system for residents of Prospect Hill—that portion of city which lies betw. Rhea Avenue and No. corp. line and from B Street to Eaton Road. As part of plan a 24-in. line abt. 18 ft. deep will be laid along B Street—Black to Gordon Sts.—which will form part of main intercept'g sewer that will eventually carry all sewage to common point below the dity. Approx. cost $150,000.

O., Lancaster—State Bd. of Health has issued order requiring city to construct sanitary sewer system and sewerage disposal plant at cost of $500,000. Council will appoint expert sanitary engr. to act in conjunction with state engineer.

O., Mansfield—Resolution adopted by Council for constr. of 8-in. sanitary sewers in sections of Marion Ave.; Glessner Ave.; Vale Ave.; W. 3rd St.; Mansfield Ave.; State St.; Chester Ave. and Marion Ave.

Okla., Guthrie—Town of Heavener will construct sewer system at cost of $40,000.

Okla., Miami—Following approval by citizens, at mass meeting, of the $494,000 bond issue, Council will call elect. to vote on bonds at an early date. It is proposed to expend $135,000 of total issue for sewer extensions and $151,000 for sewage disposal.

Ore., Oregon City—Engineers preparing sketches for constr. of new brdg. across the Willamette to replace old Oregon City span. It will have clean span of 385 ft. and height of 125 ft., $268,000. No funds arranged.

R. I., Cumberland—Town contemplates constr. of sewage system in lower section of town. Meeting of taxpayers to be held.

S. D., Wilmot—Voters have endorsed issue of bonds beyond the constitutional limit for purpose of building sewer and water systems.

Tex., Dallas—City Commrs. have ordered construction of 8-in. and 6-in. sanitary sewers on Cottonwood Street and two alleys in "Little Mexico" district. Est. cost $6,591.

Tex., Plainview—Council has voted to expend $50,000 on sewer impvts. Work includes removing plant further from city limits, installing new Imhoff tank. 9,000 ft. 15-in. main will be laid and impvts. made to system in city limits.

Tex., Vernon—City has voted $10,000 bonds for sewer and water system extensions.

Va., Petersburg—City contemplates sewer extensions. $275,000. R. D. Budd, City Engr.

Va., Truxton—Septic tank will be built by city of Portsmouth wnere sewage system of Truxton empties into Paradise Crk. Jos. Weaver, City Engr.

Wash., Yakima—By vote the taxpayers adopted plan for general sewer system and authorized an issue of $350,000 bonds to pay for constr.

Wis., Eau Claire—City voted $75,000 bonds for constr. of an adequate sewer system of trunk sewers in outlying districts of city.

Wis., Marion—Survey will be made in near future for sewerage system. L. P. Pelishek, Engr., Clintonville, Wis. V. L. Morriset, Clk.

WATER SUPPLY AND PURIFICATION

Ark., Paragould—City has retained W. R. Heagler & Sons, Engrs., City, to prepare plans for water works system.

Cal., Alamitos Bay—Alamitos Sugar Co., contemplates bldg. pipe line from its plant to the ocean to dispose of its waste water. Los Angeles Co. Supvrs. have been asked to grant permission to carry the pipe across two county roads.

Cal., Whittier—$361,000 bonds voted at recent election for purpose of developing water supply, extending distribution system and providing additional storage for municipal water system. J. B. Lippincott, Central Bldg., Los Angeles, Cal., Engr.

Cal., Glendale—City Trustees have issued statement urging necessity of voting $260,000 bonds for extensions to municipal water system and constr. of power generating plant: New pumpg. plant with 2 wells and pump for each and large booster pump at San Fernando Rd. and Grand View Ave., $33,500; new 30-in. trunk line, $35,000; 7,500,000-gal, reservoir at entrance to Verdugo canyon, $40,000; new 20-in. pressure main—reservoir to abt. middle of Verdugo canyon, $34,800; row of wells across middle of canyon to bed rock, with pumps to raise water to small reservoir or settling basin, $32,000; 16-in. pressure main, $19,000; reservoir at Grand View Ave.,

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reservoir $3,000; 5 mi. new water mains and laterals, $54,250; elec. generating plant at canyon reservoir, 100 kilowatt generator, driven by Pelton wheel, $9,700.

Cal., Los Angeles—$700,000 bonds voted for purpose of bldg, an aqueduct water supply into the West gate annex dist.

Colo., Raymer—Plans being prepared by Rohrough Engrg. Co., Engrs., 929 City Natl. Bk. Bldg., Omaha, for bldg. new water works plant here. Est. cost abt. $28,000.

Fla., St. Petersburg—W. D. McAdoo, Florida Bank Bldg., contemplates installing water works on St. Petersburg Beach.

Ga., Plains—City considering constr. of water and light system. Water system will cost about $20,500.

Ill., Carterville—New plan for providing city with water and sewerage system being considered by Mayor J. R. Phillips and alderman. A few business men of Marion have offered to put in water works system and conduct the business, if city will provide an adequate supply of water and bring it to city limits. It is now proposed to build lake no. of city and west of main highway. Mayor confident that bond issue of $25,000 will be sufficient to cover cost of artificial lake and piping water to city limits. Citizens in favor of water system.

Ill., Geneva—Town considering extending water mains on east side of the river. Council will pass Ordinance.

Ia., Ladora—$18,000 bonds voted for construction of water system.

Ia., Washta—At special election citizens voted in favor of installing municipal water plant.

Ill., Rockford—City will call election to vote on $500,000 bonds for purpose of constructing new water plant.

Kans., Dodge City—Water system impvts. not to exceed in cost $48,000, will be made as soon as practicable to begin the work.

La., De Ridder—$100,000 bonds voted in favor of water and electric light systems. C. C. Davis, Mayor.

Md., Baltimore—Walter E. Lee, Water Engr., 205 City Hall, submitted report and recommendation for increasing municipal water supply; provide for future daily consumption of 2,000,000-gals.; ultimate expendt. $25,000,000; initial expendt. $8,000,000 for 125-ft. dam., addnl. filter. system and 12-ft. tunnel, 7½ miles long.

Minn., Duluth—Ready for bids soon for water and gas mains in Jefferson Street—Greysolon Road to 24th Ave., E. and from 26th Ave. E. to 28th Ave., E. E. G. Phillips, Commr.

Minn., Foley—Plans complete for water system and sewage disp. $50,000.

Minn., Marshall—Resolution adopted and passed by Council authorizing extens. of water mains on certain streets and fire protection. A. G. Bumford, City Rec.

Minn., Pipestone—Council has ordered plans for bldg. water works plant. New well is being bored and it is proposed to erect new pumping station, construct large water and water tower.

Mont., Hardin—Council contemplates installing large filtration plant with capy. of 500,000 gals. a day; plant to be so arranged that as city grows another unit can be added. Est. cost $65,000.

Neb., Fairmont—$35,000 water and fire protection extension bonds carried at special election.

Neb., Fullerton—$15,000 bonds voted for extending water mains.

Neb., Schuyler—Council considering replacing water mains and extending with cast iron pipe. First ward will have 16,130 ft. c. i. pipe, 28 fire hydrants and 20 gate valves; Second ward, 17,800 ft. c. i. pipe, 26 fire hydrants and 16 gate valves; Third ward, 19,360 ft. c. i. pipe, 27 fire hydrants and 22 gate valves. Total 53,390 ft. c. i. pipe, 81 hydrants and 58 gate valves. E. A. Schmidt, Water Commr.

Neb., York—City considering constr. of water works plant. Est. cost $85,000.

N. D., Grand Forks—Property owners on Ramsey Street have filed petition with Council requesting that water and sewer connections be installed on Ramsey Street for a distance of two blocks. Matter taken under advisement. A. N. Briggs, City Clk.

N. D., Hankinson—Petition filed with City Council to install waterwks. and sewer system.

O., Ashtabula—Council has authorized the City Mgr. to start proceedings on extension of water mains to southern part of East Side.

O., Cincinnati—City considering extension of water mains to provide water for residents in annexed outlying districts.

O., Cleveland—Four filters and a basin at the west side filtr. plant will be repaired by the city in near future. W. H. Noble, New York, foundation engineer, has been requested to recommend methods for repairs and methods of stabilizing the subsoil to prevent another collapse. Est. cost of repairs, $250,000.

O., Cleveland—Utilities Director Farrell announces that city intends to construct a new $5,000,000 pumping station, with a five-mile tunnel reaching into the lake off the foot of E. 140th St. Studies for work now being made by Jno. T. Martin, City Water Wks. Commr.

O., Columbus—City contemplates submitting to vote of people a bond issue to amt. of $3,000,000 for purpose of extending water works system to a point made necessary by city's present growth. The purposes for which this amt. of money would be expended, according to Supt. Jerry O'Shaughnessy, will be constructing addtl. storage, purifying, softening and distributing facilities and obtaining necessary real estate and rights of way therefor. Itemized briefly: Dist. main from Scioto River to High St., at 11th Ave., with branches in 5th Ave., bet. Forsythe & Dennison, $550,000; new dam is Scioto River above Dublin, $1,250,000; reservoir above new dam, $135,800; raising present storage dam 6 ft., $123,000; enlarg'g. purification plant, $297,000; new pump'g. machy. and equipt. to enlarge capy. of present pumping station, $135,000; other contingent expenses will be met out of balance.

O., Defiance—State Bd. of Health has ordered better water supply for City. Engrs. have recommended a water filtration plant to cost approx. $200,000; the source of supply being the Maumee River.

O., Greenville—Plans for extensive improvements at water works plant will be

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prepared immediately and submitted to City Council.

O., Martins Ferry—City contemplates extending water lines out West 23rd St., and out Indian Run for fire protection purposes. Mayor and Service Director instructed to secure data regarding cost, size of mains, etc., etc.

O., Toledo—City plans to increase daily capy. of filtered water to 50,000,000 gals. Some of the work will be undertaken this Fall. Council has voted two issues of bonds; one $400,000 and the other $450,000, for the extensions the Service Director has planned in detail. $400,000 will be expended at low-pressure filtr. plant near city limits. 22 filters, each with 1,000,000 gals. daily capy., will be added. Another settling basin, 500x150x20 ft., capy. 11,250,000 gals. will be constructed.

O., Zanesville—Consit. Engr. J. Richard Kommer recommends that the air compressors be enlarged or an addition be made to them; also that additional wells be drilled in and the old ones on high level be abandoned.

Okla., Collinsville—$40,000 bonds voted for constr. of water filtr. plant. Bonds have been sold. Plans and specfs. being prep. by Johnson & Benham, Consit. Engrs., 8th flr. Firestone Bldg., Kans. City, Mo. No date set for letting contract.

Okla., Hartshorn—City considering water works constr.; $25,000; filter plant; brk. and rein. conc.; filter equipt.; daily capy. 600,000 gals. V. V. Long & Co., Engrs., 1300 Colcord Bldg., Okla. City.

Okla., Lindsay—$25,999 bonds voted for construct. water system.

Okla., Minco—Town Bd. of Trustees preparing to make extensive improvements in municipal light and water plant for which $11,000 will be expended. Citizens voted in favor of impvt. and issuance of bonds to amt. of $11,000.

Okla., Nowata—City considering water works and electric light impvts. Burns & McDonnell, Engrs., Kans. City, Mo.

Okla., Perry—$260,000 bonds voted by city to improve water, light and park systems.

Okla., Ponca City—$150,000 bonds voted by city for water works extension; $50,000 for electric plant extension and $25,000 fire fighting equipt.

Okla., Wilson—Extensive addns. to city's water supply and water and electrical distribution systems being considered by City. Contract for engineering work let to J. W. Ryder, Ardmore, and preliminary work under way.

S. A., Ecquador, Guayaquil—Senator Carrera presented for consideration of congress a bill providing for a $4,000,000 municipal loan, fully guaranteed, for the water supply of Guayaquil. Brig. Gen. Wm. C. Gorgas, formerly surgeon general of the U. S. army, will direct the work.

S. D., Belle Fourche—City will pipe

S. C., Anderson—City will install filtration plant.

S. C., Laurens—Chamber of Comm. interested in extension of water and lighting systems; also enlargement of city graded sch. bldg. Bond issue of $250,000 will have to be made by city to finance these enterprises.

water from springs on William Schmidt ranch in Spearfish valley, 12 miles from here, by gravity, fall of several hundred feet.

S. D., De Smet—City considering issuing bonds, abt. $15,000, for stand pipe in connection with local water works system.

S. D., Humboldt—$15,000 bonds voted for purpose of extending water mains.

S. D., Mobridge—Resolution adopted to constr. service water mains on certain streets. Plans with Paul Jones, City Aud.

S. D., Oneida—Petition filed with City Council asking that special election be called for purpose of submitting to voters proposition to issue $30,000 bonds for installing water works system and electric light plant.

Tenn., Greenfield—$70,000 bonds voted by City for water and electric light plants. Clyde Essell, Mayor.

Wash., Bellingham—Mayor Sells has advised Council to take steps looking to an extension of the municipal water system in South Bellingham.

Wash., Wenatchee—Council plans immediate expendt. of $50,000 for extensions to water system. Plan for improving water system involves extension of city's gravity line up the Equilchuck creek.

Wis., Milwaukee—Resolution to be introduced by Ald. Jno. Radke in Common Council, providing that city construct water filtration plant at foot of Linwood Ave. Plant will cost $3,000,000 approximately. Money will be placed in 1920 budget to make it possible to proceed with the work. City Engineer's office at work on prelim. plans. Dr. Ruhland, Health Commr., regards the filtr. system as vitally necessary to the public health. Permission of U. S. Govt. will be sought as plant may be built about 1,500 ft. out into Lake Michigan.

Wis., Stanley—Council has voted in favor of retaining engineer to draw plans for water supply and sewage disposal, including pumping station. Jesse D. Green, City Clk.

BRIDGES AND BUILDINGS

Ala., Mobile—Five new bridges will be constructed on good roads leading out of Meridian.

Cal., Lompoc—Fourth Supervisional Dist. elec. in near future, to vote on $400,000 bonds to pave surface and build bridges on portion of rd. Lompoc to Lompoc Jct.,—abt. 28 miles. Total est. cost, $500,000. Santa Barbara Co. will contribute $100,000 toward project.

Cal., Red Bluff—Bd. Supvrs. Tehama Co. having plans prepared by Weeks & Day, Engrs., Phelan Bldg., San Francisco, for 17 conc. brdgs. along state highway. Bids for first brdg. will be asked this month. $521,000 bonds voted for project.

Cal., Santa Paula—Citizens have raised sufficient money to insure erection of new bridge across Santa Clara river.

Cal., San Bernardino—Council has decided to submit bond issue of $90,000 for bldg. bridges on Arrowhead and Mt. Vernon Aves., and Third and I Sts.

Conn., Torrington—Selectmen preparing est. of cost of bldg. new brdg. at Drakesville on Torrington-Norfolk road.

Fla., Jacksonville—Resolution asking budget comm. to put $10,000 in 1920 budget to constr. conc. brdg. over Hogan St. adopted by Council.

Fla., Miami—St. Johns County intends to replace all the wooden brdgs. on the Dixie Hwy., in county with concrete structures.

Ga., Bainbridge—Commrs. Decatur Co., considering constr. of rein. conc. brdg. over Flint River. Est. cost abt. $225,000. W. G. Harrell, Chmn.; J. A. Mortlan, care State Hwy. Dept., Tallahassee, Fla., Engr.

Ill., Burritt—$35,000 bonds voted by Burritt Twp., for purpose of bldg. a new Trask bridge and approaches thereto.

Ill., Chicago—Repair of Halstead Street brdg. over Calumet River, being considered. Cook Co. may probably finance Riverdale's and Calumet's portion of the expense; Chicago, one-fourth of the $10,000 and will do the work, and Cook County paying the $7,500 balance.

Ill., Pittsfield—$3,300 voted by Barry Twp. for constr. of bridges; also to levy assessment to raise funds for graveling roads.

Ia., Wahoo—Yutan bridge will be constructed over Elkhorn River on Hwy. betw. Omaha and Wahoo. $20,000 still to be raised.

La., Harrisonburg—Catahoula parish in favor of issuing $690,000 bonds for good roads and bridge constr. where necessary, particularly over the Ouachita River at this place. Bridges will be of steel.

Mass., Springfield—Co. brdg. connecting this city and W. Springfield to cost $3,008,000, is provided for in report of Bridge Comm., headed by former Gov. Jno. L. Bates, and filed with Supreme Judicial Court.

Miss., Brookhaven—City considering sewer system impvts.; $125,000 bonds. M. L. Culley, Engr., Jackson, Miss.

Minn., Fergus Falls—Plans completed for 2 conc. brdgs. A. C. Eschweiler, 720 Goldsmith Bldg., Milwaukee, Engr.; 90-ft. span, 52 ft. wide. H. J. Collins, City Clk.

Minn., Hibbings—St. Louis County ready for bids soon for constr. of 15 bridges. Largest, 70 ft. on Meadowlands trunk road. Geo. Legman now working on this road. W. H. Borgen, Co. Aud.

Minn., Madison—Survey completed for 30-ft. r. c. deck girder span. r. c. abutms. in town of Providence. H. O. Thorson, Co. Aud., La Qui Parle Co.

Minn., Moorhead—Survey completed for bridge 3215 over Wild Rice River, Clay Co.; also for bridge 3216 over Whiskey Crk. Plans with Minn. State Hwy. Comm., 920 Guardian Life Bldg., St. Paul. Andrew Houglum, Aud.

Minn., Springfield—Brown County considering constr. of new bridge to replace Burns bridge. State Hwy. Comm. will prepare the plans soon. Louis Vogel, Co. Aud.

O., Akron—Resolution of necessity passed to sell $250,000 bonds for purpose of constructing viaduct in State St. over Ohio canal betw. Main Street and Water Street.

O., Bellaire—New bridge may soon be built over McMahon Crk. on Belmont St. Bd. Co. Commrs. has ordered Co. Engr. to prep. plans for structure. Bridge will be of concrete and cost approx. $20,000.

O., Dayton—City contemplates elec. soon to vote on $120,000 bonds to construct 2 bridges; one on Bway. and one on Deal St. over Wolf Crk.

O., Kent—Portage County will build new bridge over Breakneck Creek on Kent Ravenna paved road. Est. cost $4,700.

Okla., Enid—City Engr. Ben. Lewis has forwarded plans for 4 new bridges to state hwys. dept. for approval. Bridges will cost $6,000 each. Another bridge will also be constructed soon. Plans made and will be sent to Board for approval.

Okla., McAlester—It is absolutely certain Scio Creek bridge will be constructed in near future.

Okla., Pryor—$200,000 bonds voted to construct 6 bridges in Mays Co.

Okla., Shawnee—Co. Commrs. at Tecumseh have ordered a steel brdg. constructed over Shan Creek in Kent Twp. Bridge will be 50-ft. span and will be erected at once.

Ore., Portland—Clackamas Co. Court informed that if Ore. City and county will raise $180,000, state will furnish $100,000 additional for bldg. new bridge over the Willamette. Est. cost of which is $280,000.

Pa., Lewistown—City plans to bldg. 80 ft. span brdg. 66 ft. wide on S. Main St., probably deck gird. type conc. flr. Abt. $40,000.

S. D., Chamberlain—Authorities will be asked by Div. of Capital expenditures of U. S. R. R. Administration, for approx. $125,000 for constr. of addl. 300-ft. span on west end of present steel brdg. over Missouri River. Harry L. Gandy, Congressman.

S. D., Mitchell—Plans made at recent meeting Bd. of Commrs. Davison Co. for constr. of 23 bridges. Approx. $50,000. Thos. Eastcott, Aud.

Tex., Austin—Plans submitted by Rockwell Co., Engr., for 1200-ft. conc. bridge, approved by A. A. Stiles, State Reclamation Engr. Bridge will be built over east fork of the Trinity east of town of Rockwall.

Wis., Grand Rapids—Contr. to be let in early Winter for bridge; 500-ft. struc. with rdway and walks abt. 52 ft. Survey to be made at once and plans prepared. Approx. cost, $210,000.

Wis., Green Lake—Plans prep. by Wisconsin Hwy. Comn., for Reimer bridge, 8x24 ft. r. c. span. $12,250; Dumske brdg., 8x24 ft. r. c. span $1,150; Green Lake County. D. C. Williams, Commr.

Wis., Kneosha—Plans for constr. of new $300,000 bridge over river at Main St., together with plans for lowering of industrial trks. of C. & N. W. Ry. Co. at Main St. given approval of railway company. With this approval of the plans by the railway company, they will be turned over to Wisc. Railroad Comn. No bids can be asked until Commission also approves the plans.

Wis., Manitowoc—Plans now being drawn for brdgs. $30,000. Engrs. Klug & Smith, 40 Mack Bldg., Milwaukee. A Zander, City Clk.

Wis., Mukwonago—Wisc. Hwy. Comn., Madison, having surveys made for Mile Race bridge, r. c. 2 30-ft. spans, baluster railings and conc. abutms.

W. Va., So. Charleston—Commrs. Kanawha Co. & Charleston Interurban Tract. Co. plan to build brdg. over Kanawha River at So. Charleston. About $300,000.

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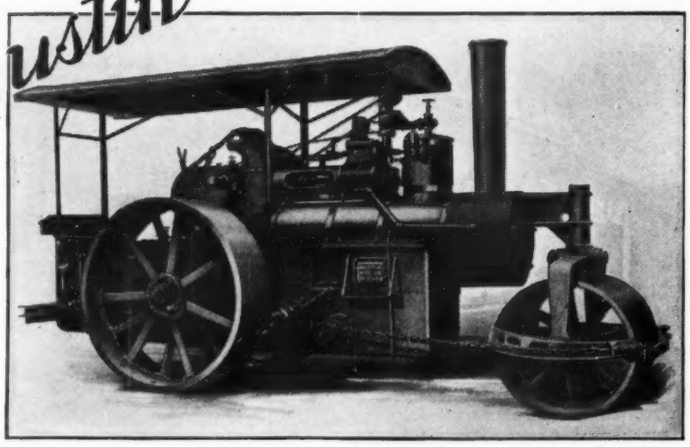

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